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Water Pollution Research.

IN India Science still remains a blushing young virgin, and industries, an unfilled stripling. They must firmly grasp each other's hands before the public can expect the fulfilment of the promise they hold to each other. Comparing the attitude of industry to-day with that of ten years ago, there is a definite indication of its increasing readiness to make use of scientific method and scientific knowledge. But it is still difficult to assess the change that is taking place in the attitude of industry in India. It seems to us that it is time for the Government of India to consider the necessity of establishing under their auspices a Department of Scientific and Industrial Research. We are convinced that, without the inspiration and influence which such an authoritative organisation can exert on the corporate and mutually dependent life and activities of science and industry, both of them will suffer from the withering atmosphere of isolated existence. Every schoolboy knows that the main purpose of science is to discover facts, and that of industry, to use these facts for the purpose of providing civilised standards of existence, so as to ensure the health, comfort and prosperity of the people. We can conceive of no factor in the modern conditions of life, more potent in promoting these desirable objects than a generous supply of pure and wholesome water for consumption in the homes of people, and in the numerous factories which minister to their daily wants. The ingredients which compose civilization sometimes form a baleful source of contamination of water, and science exerts to restore its purity. Is there in India an organisation like "Water Pollution Research" which is devoted to investigate the physical, chemical and bacteriological impurities of water for which there is greater demand in this country than perhaps in Europe? It is true that in the larger cities water used for drinking purposes is examined periodically by bacteriological institutes, and the municipalities exercise supervision of water reservoirs and catchment areas through their sanitary deparments. So far as the needs and interests of the urban population are concerned, we may presume that

they are fairly satisfactorily served. But we are thinking of the condition in the towns and rural areas.

We confess that the problem of supplying wholesome and adequate supply of water to the increasing population of India, is both complicated and difficult, but it ought not to be beyond the wit of man to devise satisfactory means for providing the people with this elementary, but nevertheless vital necessity. It is common knowledge that the general habits and the religious practices of Indian people consume far more water than what is actually required for domestic purposes. When people congregate in large numbers at places of piligrimage for purificatory baths, we can imagine the amount of damage inflicted upon the purity of water in the rivers and tanks, which without the least compunction is swallowed by man, woman and child with the most touching devotion and defiant disregard to consequences. In the rural areas, men and cattle in a spirit of absolute abandonment defile the slender sources of water supply, and if the population manages to survive such gross offences to sanitary principles, it is entirely due to the sterilizing influence of the tropical sun. The large cities are establishing industrial factories, with the consequence that the hygienic conditions of life both among the labourers and among the general population, are causing anxiety to the authorities. It is well known that rivers and tanks in the vicinities of towns are polluted in all conceivable ways and generally speaking the attitude of the ordinary run of Indian communities is that however much they may defile the air, water and earth, the business of the Deities presiding over these elements is to cleanse them and maintain their purity. Frequently the Deities neglect their duty and when epidemics break out, the only way of ridding the places of their ravages is to offer propitiatory sacrifices of goats, fowls and sheep which will restore to them divine favours. Rural India has yet to learn that epidemics and diseases are the outcome of insanitary habits, and that cleanliness of person and surroundings, abundance of pure water and air, proper disposal of refuse, and consumption of wholesome and uncontaminated food are some of the elementary rules of health ordained by the Divinity, and infringement of such rules involves dire consequences. The sanitary sense among the people is still subconscious, and it is most distressing to witness the commission of nuisance in the public thoroughfares, and it is scarcely realised that all the filth must ultimately find access to the local tanks and streams from where drinking water is supplied.

The proper disposal of sewage, street refuse and night-soil is the first step to ensure the public health, and once a service is organised towards achieving this end, the problem of supplying pure water becomes comparatively easy of solution. The public and governments are slow to recognise that there are heaps of gold in the condemned filth, which after careful chemical treatment must be returned to the soil. In nature there is no such thing as waste, and it is only our ignorance which blinds us to its value and importance. The experimental work on the investigation of the activated sludge process of purification of sewage, conducted at University College, London, has yielded important results, both in regard to the primary stage of clarification of removal of organic matter by absorption by the sludge, and also in regard to the secondary the stage of slow biological oxidation. In India the researches of Dr. Gilbert Fowler, an eminent authority on the subject, has led to the devising of various methods of obtaining sterility of sewage, besides pointing to the process of the application of the treated material to the soil. The results of his experiments carried out on the influence of certain factors, such as temperature, pH value, concentration of carbon dioxide on the rate of oxidation of sewage and activated sludge are of great practical importance in so far as they establish the conclusion that the greater part of the oxidation of sewage by air is dependent on the presence of certain enzymes, whose most potent source of oxidising activity appears to be bacterial cells. When there is such a wealth of information easily available for ready application, the tardiness of municipal administrations in taking advantage of the town refuse being converted into wealth is unaccountable. It seems to us that researches should be undertaken in the chemical laboratories which possess sufficient equipment for them, to investigate the enzyme

activity of activated sludge also towards pure substances, and we have no doubt that the results of such investigations will have far-reaching practical importance in almost all the industrial processes.

When a Water Pollution Research Board is established in India, we can easily conceive the vast amount of difficulties and complicated problems confronting its members, and those of the rural population should engage their immediate attention. It is, however, conceivable that the efforts of the Board to introduce improved and sanitary arrangements will become infructuous if the people have not been sufficiently educated to appreciate and practise hygienic methods in their daily life. The education of village should have a direct bearing on the realities of life, and health education should form a large part of their programme of studies. The fresh-water Biological Sections, which must be a department of the Board and whose studies will be to investigate the biology, chemistry and physics of fresh-waters in relation to their behaviour of the fauna, ought to be able to convince the adult members of the rural population by means of demonstrations that contamination of drinking water is the direct cause of most of the preventible diseases to which ignorance victimises them. The villager must realise that whatever may be his affection for the cattle in his service, it is positively dangerous to both to have a common source of water supply, and that the tank used for taking drinking water is terribly contaminated if used by him and his herd as a bath tub. Polluted water in the villages undermines the health and efficiency of the people and their contribution to the public revenues, and till better conditions are introduced, they must necessarily be unsatisfactory.

In the towns and cities, the first consideration of the Board ought to be to convince the municipalities about the paramount urgency of providing water closets in suitable places in all the principal streets so as to prevent people from committing nuisance in open diliance of all the rules of sanitation and decorum. Without such provision for the convenience of the users of public thoroughfares, it is meaningless to enact measures for the prevention of pollution of the roads, and it is surprising how under such circumstances the administrators of justice can take cognisance of offences. In the towns the sewage problem becomes complicated by the most baleful intervention of men and stray animals, and unless the municipalities acquire some active control for the mitigation of pollution from these two sources,—which is a prerequisite for any comprehensive programme of research studies,—the evils arising from the use of contaminated water must continue to afflict the urban population. Closely connected with the organisation for the treatment and disposal of town refuse, is the imperative necessity of rebuilding most of the towns according to sanitary principles. Old towns will automatically cease to exist, if the municipalities acquire building sites and create modern facilities and amenities of civilised life for the people in areas in the neighbourhood, and if an active programme of town planning is launched it will immediately solve some of the more acute sanitary problems which distress the towns at the present moment.

The populaton of India, when the census of 1941 comes to be written, will certainly reveal a most disconcerting increase, and if no machinery is set up in time to investi gate and solve the health problems of this stupendously large community, beyond the provincial public health departments, we fear that conditions of existense will soon become appalling. The problems as they are, have assumed continental proportion, and the machinery to deal with them must be correspondingly comprehensive. The establishment of a Water Pollution Research Board under the Central Government, working in collaboration with the provincial health departments may provide the necessary palliative, and if the necessary funds and research workers should be forthcoming, India will be a paradise of sweetness and light.

The All-India Museums Conference.

TO consider what can best be done to improve the condition of the museums of the country the Government of India arranged for a conference of museum curators, which was held in Delhi early in December 1937. An inaugural address was delivered by Sir Girja Shankar Bajpai, Secretary to the Government of India, Department of Education, Health and Lands, who entertained the delegates to tea in his garden at the close of the conference, after which facilities were provided for the delegates to visit the museums of either Lahore and Taxila or Dehra Dun. While in Delhi excursions were arranged to archæological museums and places of historical interest, Rao Bahadur K. N. Dikshit, Director-General of Archæology in India, entertaining the delegates to tea in the Fort. Dr. F. H. Gravely, Superintendent of the Government Museum, Madras, was elected Chairman of the Conference, which was a large and representative gathering.

The calling together of the Conference at this time was due to the publication of the report on "Museums in India" which formed the subject of our leading article for April 1937, and the resolutions passed, which have recently been received, naturally follow in the main the recommendations of that report, the only important deviation being in regard to means for the better co-ordination of the work of different museums in future.

Resolution I suggests means for stimulating and maintaining public interest in museums. Resolution II deals with the position and training of curators, referring this important but difficult matter to a proposed continuation committee for detailed consideration. Resolutions III and XIV deal with the question of funds. Resolution IV makes concrete proposals for a continuation committee. Resolutions V and XII deal with educational activities. Resolution VI emphasises the position of the Indian Museum, Calcutta, as the national museum of India and advocates its further development as such. Resolutions VII and VIII refer to museum buildings and the desirability of museum legislation respectively. Resolution IX stresses the need for more thorough conservation work, especially on the part of curators themselves. Resolution X deals with relations between museums for particular sites and those for wider purposes. Resolution XI appeals for the removal, in the case of scientific publications, of the restrictions that have been placed by certain governments on exchange of publications, a system on which scientific libraries are largely dependent for their proper development. And resolutions XIII and XIV refer to the work of Messrs. Markham and Hargreaves, thanking the Carnegie Institution for making it possible and thanking the Government of India for their arrangements for the Conference.

As already mentioned, the only resolution that departs widely from the recommendations of Messrs. Markham and Hargreaves' report is the one dealing with means for continuing the work for which the Conference was called together, *i.e.*, resolution IV. The Report recommended two agencies for this purpose, an Inspector-General of Museums to be appointed by the Government of India, and a Standing Committee on Museums to be re-established with provision of sufficient funds to meet its cost, including travelling allowances, etc. A Museums Association for India is also mentioned as obviously desirable, but dismissed as impracticable at present. The appointment of an Inspector-General of Museums having found favour neither with the Government of India nor with the Museums, the Conference found it necessary to consider whether a Museums Association might not after all be possible, especially as some of its members were already trying to form one in connection with the Oriental Conference, of which the Trivandrum meeting was then to be held in the very near future. Though the wish for such an Association was shared by all members, the difficulties in the way of establishing it immediately were equally apparent and it was finally resolved that "This Conference is of opinion that a Museums Association of India should be established as soon as possible and with this end in view it appoints a Standing Committee to devise ways and means for bringing it into existence, or for making such interim continuation arrangements as may prove to be necessary. This Committee will become the Council of the Association on the formation

of the latter. The Conference considers that it should as far as possible be representative of the different Provinces and principal States." This Committee was instructed to meet immediately in order to appoint an Executive consisting of not more than five members and one secretary, which was done, Mr. S. H. Prater, M.L.A., of the Prince of Wales Museum, Bombay, being asked to be Secretary. And it was further pointed out that this Committee would not be able to carry on its work without funds for a clerk, type-writer, stationery, etc., as well as for occasional travelling expenses, for which the Government of India was asked to arrange. Such expenses should obviously not be great, however, and could presumably if preferred be contributed by all the various agencies responsible for the upkeep of museums throughout the country, in which case the individual contributions needed would be very small indeed.

In the course of his inaugural address Sir Girja Shankar Bajpai said to the Conference, "You may rest assured that I have not been sent here to read out what some historian of the future, with a turn for irony, might truthfully describe as the official epitaph of the Markham-Hargreaves' report. The Central Government are genuinely anxious to do whatever in them lies to remedy the defects to which that document has given just prominence." As the first step towards remedying them must clearly, if there is to be no Inspector-General, be the establishment of a small and efficient expert committee to devise ways and means of improvement and to take such further steps as seem most practicable for getting them put into practice, these words can only mean that the Central Government are fully prepared to take the necessary initiative in establishing such a committee on a sound basis. And in the interest of a powerful but much neglected means of developing education and general culture throughout the country we urge them to do so without further delay.

Postulates in the Relativity Theories of Gravitation.*

By V. V. Narlikar.
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SINCE Thomson and Tait published their celebrated work which was known at Cambridge, as the Natural Philosophy of T and T′, there have been many theories of gravitation and many relativities. The first noted rebel against Newton was Mach and his clearer conceptions of space, time and inertia have considerably influenced modern research. During the last thirty-five years we have had mathematical relativities due to Einstein, Milne, Synge, Page and Sir Shah Sulaiman. To this list may be added the relativities propounded by philosophers like Broad, Levy and others; but these relativities belong to a different region of thought as a remark from Alexander's work will show, *viz.*, that 'Space is the Body of God and Time is His Soul'. During the last few years and particularly the last few months much basic work has been done on relativistic gravitation from the mathematical point of view. Important papers have been published by Milne, Robertson, Walker, Hoffmann and Whitrow. Although the treatment in some of these papers is obscured by unfair criticism a few of the conclusions reached go very deep and they explain the interconnections between different theories. One is amazed to see how results proved in the theory of groups more than thirty years ago come out useful in this connection.

In the Newtonian theory gravitation means attraction. In Einstein's theory gravitation is interpreted in terms of Gaussian curvatures for a Riemannian space-time. In Milne's theory gravitation is to be understood from the kinematical consequences of the cosmological principle. The fact is, as Eddington and Milne have stressed, that there is probably no such thing as a law of gravitation: but there are a number of gravitational situations. The gravitational situations are provided by

* From a lecture delivered at the Mathematical Conference, Lucknow, March 16, 1938.

the 'falling apple' and the shapes, sizes and motions of the celestial bodies. The atomic nature of matter is itself a gravitational situation but no theory has so far succeeded in explaining it. The macroscopic aspects of the world-structure provide many interesting gravitational situations such as the red-shift and structure of the nebulæ and no modern theory of gravitation can be complete without a cosmology of its own. From the scientific point of view a cosmical situation is as important as the Kepler problem and cosmology can no longer be treated as a speculative attempt to reconcile God with gravitation. A gravitational situation is usually attributed to two sets of causes at work: one is recognised as the set of local causes and the other as that of distant causes. The laws of operation exclusively of the distant causes belong to the domain of cosmology. In the Newtonian theory the effect of the distant causes is summed up in the law of inertia according to which every body, in so far as it can, perseveres in its state of rest or of uniform motion in a straight line. This must be recognised as a law of Newton's cosmology. It furnishes a substratum of bodies in uniform rectilinear motion relative to each other. On the background of this substratum the local causes, which are called forces, are studied to obtain the inverse-square law. In Einstein's theory the flat space of the special theory was found to give the substratum but, later, the theory had to be modified and the substratum was found to be given by a non-static model of the universe of the Friedmann-Lemaitre type. The local causes in this theory are found to be responsible for a curved, Riemannian, space. Even in Milne's theory the classification of causes is made in this manner, the distant causes being responsible for the substratum of particle-observers with kinematical and statistical equivalence while the local causes explain the inverse-square law. The acceleration of a test-particle has been expressly split up by Milne into two parts: one due to the local causes and the other due to the distant ones.

One consequence of this splitting up of the causes into two classes is to give rise to the concepts of 'private' and 'public' space, and of 'private' and 'public' time for the sake of recording the two types of phenomena. As Newton assumed the objective existence of the space-time frame he made no distinction between a private space-time and a public space-time. Mach has pointed out the weakness of Newton's ideology in this connection. In the general theory of relativity the term used is cosmic space-time and not public space-time. The current view is that the cosmic space-time is non-static and hyperbolic. But it must be stated that nothing like the last word has been said on this question. Milne's public space-time can also be shown to be non-static and hyperbolic although the private space-time of each of the particle-observers is Euclidean.

A gravitational situation may also be analysed, in contradistinction to the procedure of Newton, Einstein and Milne, into macroscopic local causes and microscopic local causes. The early attempts by Sir Shah Sulaiman to explain gravitation by means of gravitons and the similar attempt by Synge to explain gravitation by similar particles illustrate this procedure. Synge has evidently not made any progress with his hypothesis and Sir Shah, if I understand right, has now abandoned the gravitons-hypothesis. Any theory whose equations run close to those of Newton's may, in certain cases, give results more satisfactory than Newton's or than those of another theory running close to Newton's. In such a case the superiority of one theory over another can be judged only on the merits of the postulates. One should like to see a clear statement of Sir Shah's postulates so that one may compare them to Newton's. The postulates have got to be very carefully chosen as they are likely to land one into a contradiction. Page's work is an illustration of this. He started on Milne's lines but with particle-observers in a state of uniform acceleration relative to each other and when he found that the line-element of Special Relativity could not be obtained he arrived at the conclusion that his relativity had disproved Einstein's relativity. A mistake was in his postulate that the velocity of light is rectilinear and uniform even in the accelerated frame. The transformation that he claimed to have discovered was known to the students of the theory of continuous groups in 1904.

A postulate in Einstein's theory is that the space-time of a gravitational field is Riemannian. One objection to this is that

it limits the nature of physical space.* An observer must have the freedom to choose his geometry. Poincaré has stated that physical space has no objective existence. Whitehead has objected to this postulate from another point of view. He objects to the casual heterogeneity of space-time on grounds that with such a space-time an observer either knows everything or cannot know anything. If the space-time frame is to be constructed by an observer from his own experiences Whitehead's objection is valid and the procedure adopted by Milne in his theory seems to be the correct one. Robertson has tried to show that even with Milne's procedure a Riemannian line-element is obtained. But it is not as general as Einstein's line-element with ten unknown $g_{\mu\nu}$ and while Milne obtains the equations of gravitation from his precedure Robertson has not obtained them. Milne's procedure is as follows.

Milne has introduced the idea of a particle-observer that is an observer who is located at a point, at any instant, like a particle. Every particle-observer is equipped with a theodolite to distinguish one direction from another, an apparatus for sending and receiving light-signals and a time-sense in order to distinguish whether an event E_1 took place before E_2, after E_2 or simultaneously with E_2. The observer is thus able to represent events by real numbers. It is assumed that such an observer can make observations only at himself. He also associates as a convention a constant c with his signals which enables him to define in a simple manner a space-time frame and also the transformation connecting it with the space-time frame of another observer. It may be noted that in the special theory of relativity laws of nature are supposed to run the same course with respect to observers in uniform relative motion but in the general theory the laws are supposed to be expressible by covariant equations with respect to Gaussian transformations. The Restricted Principle is in keeping with Milne's attitude, but according to him, the invariance with respect to Gaussian transformations and not with respect to particle-observers is a very stringent condition put by general relativity. Milne has therefore proposed the cosmological principle. If A and B are two of the particle-observers they are said to be kinematically equivalent when the totality of A's observations on B can be described in the same form as the totality of B's observations on A. A and B are said to be statistically equivalent when A describes the world including A and B in the same statistical terms as any B. If the observers possessing this two-fold equivalence are called privileged observers the cosmological principle says that corresponding to any moving particle P in the field of a privileged observer A there is another similar particle P in the field of any privileged observer B at the same instant. Milne initially adopted the hypothesis that his observers are in uniform relative motion. But Whitrow has been able to show that with a proper graduation of clocks this assumption can be dispensed with.

For the study of local causes Milne introduces a system of test particles in statistical equilibrium satisfying the Cosmological Principle and an equation like Boltzmann's. From the motions of the test particles Milne has been able to deduce the inverse-square law and equations resembling those of Newtonian dynamics when the observer's private time is changed for the public time. It is evidently a defect of the theory that observers cannot be associated with the particles providing the local causes.

It has been recently shown by Whitrow that Milne's cosmological principle can be replaced by a sample principle and the postulate of spherical symmetry applied by each particle-observer in his neighbourhood and not with respect to the entire universe. It is instructive to compare the content of the sample principle with that of the uniformity postulate used by Robertson. Starting from this postulate and with particle observers such as Milne's Robertson deduces the non-static line-element for the universe and also kinematical and statistical systems similar to Milne's. According to the uniformity postulate 'the description of the whole system as given by A in terms of his immediate measurements is to be identical with the description given by any other fundamental observer B in terms of his measurements.' The sample principle is concerned with observations in the observer's neighbourhood while the uniformity

* Whittaker's review of Milne's recent book "Relativity Gravitation and World-Structure," published in *The Observatory*, 1935, may be referred to on this point.

postulate is concerned with world-wide experiences. Walker has also deduced some of the results obtained by Robertson by using the postulate of spherical symmetry. Robertson has particularly stressed the necessity of superposing a law of gravitation on the kinematical system. On the other hand, Milne has proceeded to explain all gravitational situations as essentially kinematical situations. He has argued that it is not right to derive the material content of a non-static universe, as it is done in relativity, by using gravitational equations which account for both the local causes and the distant causes.

One upshot of all these researches is that if Milne is right, a theory of gravitation must be, in the last analysis, divested of conceptional terms and that if there is anything like a law of gravitation it must be tautological with some fundamental uniformity postulate of an observer's measurements in his own neighbourhood; and, if Poincaré is right, a uniformity postulate of this nature should not restrict the geometry of space-time.

Note (added in proof).—The attention of the reader may be drawn to the recent paper by Milne and Whitrand in *Z. für Astrop.*, **15**, 5, 342 where other important references will also be found.

Irregular Meiosis and Abnormal Pollen-Tube Growth Induced by Acenaphthene.

By Dontcho Kostoff.

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CHEMICAL agents like chloral-hydrate, chloroform, ether, alcohol, nicotine sulphate, lactic acid, etc., have been used for inducing irregularities in the mitotic and meiotic processes,[1,2,3,4] which might lead to formation of heteroploid and polyploid cells. More effective agents for this purpose are colchicine[5,6,7] and acenaphthene.[7,8,9] These two chemical agents reduce or completely paralize the activity of the factors that condition the arrangements of the chromosomes into a regular metaphase plate (equatorially) and the formation of a regular spindle. In fact, these two phenomena are causally linked. In the previous publications I recorded some data upon the irregularities of the mitosis induced by these two agents. In the present paper I am giving some new data upon the irregularities in the meiosis and abnormalities in the pollen-tube growth induced by acenaphthene.

For studying the effect of acenaphthene upon the procedure of the meiotic processes, shoots with floral buds from *Nicotiana* species were covered with test-tubes (glass) as shown in Fig. 1. The walls of the tubes were moist and covered from inside with acenaphthene crystals, which sublimate small particles that act upon the buds. In some experiments crystals were also put on the buds directly in addition to those on the tube walls. The test-tubes were closed by cotton from downside in order to keep a

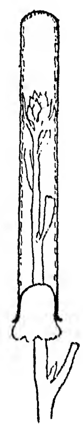

FIG. 1.

A tobacco shoot with floral buds covered with a test-tube (glass) and closed from downside with cotton. The inner sides of the tubes are covered with crystals of acenaphthene.

greater concentration of the sublimating particles around the floral buds.

By this method I treated shoots for 2, 3, 4, 5, 6 and 7 days. The parts of the stems that were under the action of acenaphthene particles in the test-tubes get visibly swollen in 6–7 days. The diameters of *Nicotiana longiflora* treated stems, for example, became

about twice as thick as the lower untreated parts below the tubes, while in the controls the corresponding parts of the stems were thinner than the lower ones that corresponded to the parts below the tubes. The flowers that developed inside the tubes with acenaphthene were shorter and broader. Floral buds treated 2, 3, 4, 6 and 7 days with acenaphthene had abnormal meiosis. I have studied the meiosis in the following nine tobacco species: *N. rustica* ($n = 24$), *N. tabacum* ($n = 24$), *N. glauca* ($n = 12$), *N. paniculata* ($n = 12$), *N. Langsdorffii* ($n = 9$), *N. Sanderæ* ($n = 9$), *N. Cavanilessii* ($n = 12$), *N. longiflora* ($n = 16$) and *N. megalosiphon* ($n = 20$).

During the first metaphase I found usually the same number of bivalents that they appeared in the normal untreated branches, namely: in *N. longiflora*—10 bivalents, in *N. Langsdorffii* and *N. Sanderæ*—9 bivalents, etc. (Fig. 2), but in the treated material

FIG. 2.

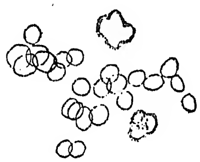

FIG. 3.

FIG. 2. Abnormal appearance of the bivalent chromosomes during the first metaphase in a PMC of *N. Langsdorffii* ($n = 9$) (regular metaphase plate, normal spindle and polar orientation of the bivalents fail) after treatment of the shoot with floral buds with acenaphthene for two days (comp. Fig. 1).

FIG. 3. Phase that corresponds to second anaphase from a *N. Langsdorffii* PMC after treatment with acenaphthene.

bivalent chromosomes were not arranged in normal metaphase plates at the equator as they were in the untreated material. Bivalent chromosomes had not a polar orientation; spindle was not formed and the bivalent chromosomes appeared disorganised during the I metaphase reminding of their appearance during the diakinesis (Fig. 2).

Absence of spindles during both divisions and failure of polar orientation of the chromosomes is the cause for the great irregularities observed in the subsequent phases. The chromosomes from the I metaphase begin to spread irregularly in the cytoplasm. They undergo interkinesis in several groups (rarely in one group) and during the "second meiosis" they get distributed in many more groups in the cytoplasm.

At the end of the phase that corresponds to the second anaphase the chromosomes were spread abnormally in the cytoplasm in groups of several chromosomes or even of single chromosomes (Figs. 3, 4). Each chromosome group or even each chromosome gets surrounded with nuclear membrane, thus at the end of the meiosis numerous nuclei (instead of four) are formed. The

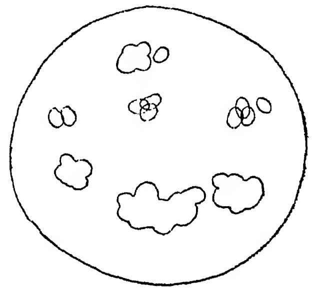

FIG. 4.

A pollen-mother cell from *Nicotiana megalosiphon* after treatment with acenaphthene. Note the irregular spreading of the chromosomes in the cytoplasm.

cytoplasm contracts around each nucleus or group of closely situated nuclei so that a variable number of microspores are formed. Each microspore has one nucleus or more than one (Fig. 5). The number of the microspores formed depends: (1) on the amount

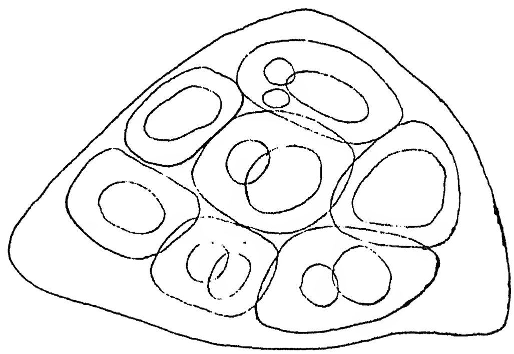

FIG. 5.

A pollen-mother cell from *N. megalosiphon* with seven (instead of four) abnormal microspores, each one having one, or more than one nucleus, formed under the influence of acenaphthene.

of the acenaphthene crystals in the tubes and (2) on the chromosome number of the

species treated. When I have put a relatively small amount of crystals in the tubes, from which a smaller amount of acenaphthene particles have been sublimated, the irregularities in the meiosis were not great and the number of microspores was not very large. In pollen-mother cells (PMC) taken from floral buds that were treated with relatively small amount of acenaphthene crystals, a tendency of equatorial arrangements of the chromosomes was observed. In those taken from buds that developed into tubes with a large amount of acenaphthene crystals no such tendency was found. On the contrary, each pollen-mother cell, from buds treated with large amount of crystals, had very irregular meiosis, and during the "tetrad" stage normal tetrads were not found. The treated species *N. rustica*, *N. tabacum* and *N. megalosiphon* having larger chromosome number than the other species, formed many more microspores than the other *Nicotiana* species with smaller chromosome number.

The meiotic irregularities induced by acenaphthene lead to formation of a large number of abortive pollen (50–100%). In *N. rustica* and *N. megalosiphon* flowers, that developed from buds treated during the meiosis with large amount of acenaphthene, I found usually 100% abortive pollen. Single large viable pollen grains were rarely found. Considering this fact I applied acenaphthene for producing egg cells with abnormal chromosome numbers.

Pollinating such flowers with normal pollen, I am attempting to produce various chromosomal aberrants.

Working further upon the methods for producing chromosomal aberrants after acenaphthene treatments, I studied the reaction of the pollen-tube growth to the acenaphthene particles. Ripe stigmas from castrated *N. tabacum* flowers were pollinated with normal pollen of the same species and at the same time a few acenaphthene crystals were added to each stigma. The lower parts of these flowers were then immediately immersed in small short (ca. 2 cm.) tubes with water and transferred to a glass cylinder (6 cm. diameter and 11 cm. height), the walls of which were moist and covered with acenaphthene crystals. The glass cylinder was covered then with moist Petri-dish which also was covered from inside with acenaphthene crystals. After 18 hours, the flowers were taken out of this cylinder and the pollen germination was studied in aceto-carmine preparations. In doing this I found that the majority of the pollen germinated abnormally under the influence of acenaphthene. The swelling of the ends of the pollen-tubes was the most striking abnormality found, sometimes branching of the tubes were observed. Several abnormal pollen-tubes were drawn and are given in Fig. 6. In the same figure a normal (N) pollen-tube is drawn for comparison. The

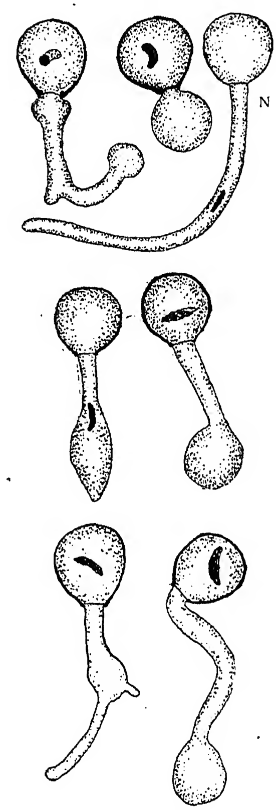

FIG. 6.

N. tabacum germinating pollen under the influence of acenaphthene; *N*—pollen grain has germinated on *N. tabacum* stigma at normal conditions while all the others have germinated on *N. tabacum* stigma on which a few crystals of acenaphthene were added and the flowers were put overnight in a glass covered with Petri-dish, the walls of the glass and Petri-dish being covered with crystals of acenaphthene.

abnormalities induced by acenaphthene in the pollen-tubes might prevent further the growth which will lead to a failure of fertilisation.

On the basis of the observations given above in connection with those reported in the previous publications upon the reaction of plant cells to acenaphthene particles one can make the following inferences :—

1. Acenaphthene induces swelling of the plant organs but at the same time a slow development in length. This obviously results from the enlargement of the cell volumes due (*a*) to chromosome duplications, (*b*) to a simple cell expansion, and (*c*) to suppression of the cell division.

2. Acenaphthene particles act upon the dividing cells during the mitosis and meiosis in a specific way which is expressed in an absence of equatorial arrangements of the chromosomes and an absence of regular spindles.

3. The chromosomes divide but do not separate; thus duplication of chromosomes takes place. Sometimes (especially during the meiosis) the chromosomes get abnormally spread into the cytoplasm. This phenomenon leads to polynucleation and further to formation of polyads during the meiosis. Consequently acenaphthene might induce polyploidy and heteroploidy. Pollen developed from polyads are usually unviable.

4. Acenaphthene does not induce chromosome rearrangements of the type X-rays do induce, or if it does, they are so insignificant that I have not been able yet to detect them.

5. The appearance of the expected numbers of bivalent chromosomes during the meiosis suggests that acenaphthene does not prevent chromosome pairing. Special experiments are required, however, for studying the question : 'does acenaphthene reduce synapsis ?''.

6. Acenaphthene interferes with the normal growth of the pollen-tubes, inducing swellings at the growing ends.

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Medical and Veterinary Importance of Fleas and Ticks and the Possibilities of their Control.*

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FLEAS and ticks are external parasites of great economic importance on account of their blood-sucking habit. They transmit numerous diseases to man and domesticated animals, and are also harmful to them in other ways. They have thus a direct bearing on medicine and veterinary science, and an indirect bearing on agriculture through affecting the efficiency of work in man and his live-stock by lowering their vitality.

(A) Fleas.

Fleas affect man and domestic animals in two ways : firstly, as vectors of diseases and secondly, as blood-suckers and annoyers of man and domestic animals.

The chief interest of fleas centres round their connection with the bubonic plague due to *Bacillus pestis*, which is primarily a disease of rodents from which it is transmitted to man by fleas. This disease has played havoc with man from times immemorial and is caused largely, if not exclusively, through the agency of fleas. In India alone upwards of 7,000,000 deaths, due to this disease, have occurred between the years 1896 and 1911. The disease is transmitted by the bite of an infected flea in which the regurgitation of blood due to the obstruction of the proventriculus introduces the plague bacilli in the body of the host. The proventriculus is blocked by the rapidly multiplying plague bacilli which

* Remarks in a discussion of the Sections of Zoology, Medical Research, Veterinary Research, Entomology and Agriculture in the Silver Jubilee Session of the Indian Science Congress Association, Calcutta, 1938.

enter the interstices of its spinous processes and thus the blood cannot enter the stomach of the flea. This obstruction proves fatal not only to the host but also to the flea. So plague is as much a disease of the flea as it is of rodents and man. This obstruction occurs more readily in some species like *Xenopsylla cheopis* the most efficient vector of plague bacilli, but it does not occur according to Hirst (1926, p. 198), in *X. astia* the inefficient transmitter of plague.

Fleas are suspected vector of *Kala-azar*, though competent opinion is still divided. *X. cheopis* according to Nicolle and Sparrow (1935) can transmit the causative agent of Tsutsugamushi fever under experimental conditions. Fleas can also transmit Rickettsial diseases in man. *X. cheopis* and other fleas have been incriminated as vectors of different kinds of typhus fevers in different countries. Hæmorrhagic septicæmia, a fatal disease due to *Pasteurella boviseptica* in cattle, is transmitted according to Daubney, Hudson and Roberts (1934) in tropical countries by *Ctenocephalides felis*. Fleas belonging to the species *C. canis* act as the intermediate host of the tapeworm belonging to the species *Dipylidium caninum* which is found in dog and occasionally in man. The tapeworm gains entrance to a new host by being swallowed with crushed or living flea.

Besides the transmission of diseases, fleas are troublesome parasites. In many cases they are said to have rendered houses or other places uninhabitable for a time. The Sticktight flea (*Echidnophaga gallinacea*) is responsible in tropics and certain parts of the United States of America for a considerable annual loss to poultry breeders. The young chicken when heavily infested often die quickly but older fowls are more resistant. The fleas materially reduce the egg-laying capacity and check the growth of fowls. The Chigoe (*Tunga penetrans*) causes painful sores in man or even crippling if neglected. During the Great War (Jolly, 1926) in the East Africa the British Army had to wait for two days to occupy a position of great advantage vacated by the Germans, on account of its being infested with fleas of this species.

Fleas afford us a good instance that a mere systematic study of a group sometimes helps to clear up certain points of great economic importance. The Indian Plague Commissioners failed to understand the reason why certain large areas had severe plague while others having similar ecological conditions were comparatively immune from it. The reason was found out by Hirst, who submitted a collection of fleas from two plague-free cities of Madras and Colombo to the Late Hon'ble N. C. Rothschild who determined the fleas to be different from *X. cheopis*—the most efficient vector of the plague bacilli—and they belonged to a new species *X. astia* which later on was experimentally proved to be a relatively inefficient vector of the plague bacilli. It was subsequently found out by some workers that in the plague free places rats are infested mostly with *X. astia* and in areas infected with plague *X. cheopis* predominated. Thus a much despised systematic entomologist was instrumental in solving the problem of a great economic importance, which the trained applied entomologists with enormous funds at their disposal could not do within a period of seven years.

A fairly large amount of work on the ecology of fleas has been done. The effects of different kinds of food and different temperatures and humidity on the growth of fleas and their earlier stages has been ascertained in some cases. A technique for rearing and maintaining large stocks of fleas for experimental purposes has been devised by Leeson (1932, *b*). By following his methods the present author was able to maintain a stock of fleas at Cambridge larger in number than the human population of Cambridge for about two years. The work of Bacot (1914), Bacot and Ridewood (1914), Strickland (1914), Hirst (1926), Leeson (1932, *a*), Mellanby (1933), Sikes (1930, 1931), Buxton (1931) and Sharif (1937) on the effect of temperature, humidity and food on the increase and decrease of the population of fleas deserves to be mentioned.

It has been found that in most species the temperature of about 23° C. and 80 to 90 per cent. relative humidity are most suitable for successful breeding of fleas. High relative humidity is an essential condition for the growth of the larvæ of fleas, but not so much for the adult. Sikes (1931) proved experimentally that different kinds of food of flea larvæ have different hygroscopic properties and the optimum atmospheric humidity differed according to the kind of food employed so as to give the optimum water-content of the food. Rainfall

and high relative humidity of 70–90 per cent. have much to do with flea breeding. As a rule rainy months in summer are responsible for outbreaks of fleas, and extremely hot and dry weather retards their breeding.

Bacot (1914) showed experimentally that the larvæ of many species of fleas require blood in their food and will not grow without it. In nature it is supplied by adult fleas, which swallow more blood than they can digest, so that some of it is discharged along with fæces as scarcely digested blood. Sharif (1937) has experimentally proved that blood, although the most important part of the nutritional requirements of flea larvæ, is by itself not sufficient for their normal and successful growth. The flea larvæ require an additional food which in nature is supplied by the organic refuse present in the bed of the host of the adult fleas. He has further proved experimentally that flea larvæ require blood for their development in order to obtain the necessary supply of iron for their growth.

The effect of the above-mentioned ecological factors on the increase and decrease of the population of fleas is established. If those who are engaged on the work of prevention of diseases transmitted by fleas will take advantage of the researches of the above-mentioned workers, they will be able to understand the flea problem, and thus partially, if not exclusively, save the human race from its depredations. Fleas breed mostly in dust containing organic material protected from wind, rain and sun, but at the same time supplied with moisture due to urine and fæces of their hosts. If breeding places of fleas, which are mostly the resting places of their hosts, are carefully cleaned up, the premises will be cleared of fleas even though no attention is paid to the fleas on the hosts themselves. The location of breeding places of fleas is essential for their control. Future researches should be concentrated on studying and understanding the ecological factors governing the breeding places of different species of fleas. In flea-infested districts it is advisable to avoid the use of mattings and carpets as they afford facilities for their breeding.

(B) Ticks.

The importance of ticks as disease carriers in man and domesticated animals is well known. They rank among man's worst enemies. There are probably none of the external parasites of domestic animals of more importance to the stock raiser in any country than the ticks, owing to the large number of diseases which they transmit from animal to animal. It is, therefore, safe to state that no more important problem than the eradication of cattle ticks confronts the farmers of any country.

The harmful effects caused by ticks to animals may be due to (*a*) tick-bite, (*b*) extraction of blood, (*c*) transmission of diseases and (*d*) tick toxæmia. It is obvious therefore that the owner of livestock cannot afford to ignore the presence of ticks on his animals if he wishes their efficiency to be maintained.

(*a*) *Tick-bite.*—It is a well-known fact that the bite of a tick causes ulcers or small wounds which may serve as points of ingress of bacterial infections. If the wounds caused by tick-bites are large the eggs may be laid by flies which develop into maggots and cause cutaneous myiasis. Ticks occurring on legs and between digits of feet in sheep and cattle give rise to sores resulting in lameness. The ticks also irritate the animals by their bites and they may die of "tick worry". *Argas persicus* and *Argas reflexus* may kill fowls or pigeons in a very short time if they attack in large numbers, quite apart from any disease they may convey.

(*b*) *Extraction of Blood.*—The extraction of blood by a large number of ticks makes the cattle so weak that they are depreciated in value from the commercial point of view. It makes them unfit for work and in milking animals the yield of milk is reduced to a considerable extent. The emaciated condition of the cattle is mainly due to the presence of a large number of ticks. Repeated attacks by large numbers of ticks shorten the life of animals, and make them weak so that they become an easy prey to other diseases. The massive tick-infestation even causes death of animals either due to excessive blood sucking or to tick worry. "In extreme cases, Mr. Mayer estimates that as many as 200 pounds of blood may be withdrawn from the host during a single season. This makes a gain in weight impossible even in the best of pastures" (*vide* Hunter and Hooker, 1907, p. 11).

(*e*) *Transmission of Diseases*.—The importance of ticks in general as vectors of various diseases of man and domestic animals continues to increase as our knowledge of them progresses. Smith and Kilborne (1893) made the first remarkable discovery of the possibility of transmission of protozoal parasites by Arthropod hosts by demonstrating the transmission of *Babesia bigemina* by *Boophilus annulatus*. This discovery by Smith and Kilborne opened up a vast field of research on the part played by Arthropods in the transmission of protozoal diseases, which has since then revolutionized our knowledge of tropical diseases. In man ticks transmit the causal agents of the relapsing fever (spirochætosis) all over the world, the Rickettsial diseases like tick-typhus fever, Marseilles fever and the Rocky Mountain spotted fever of America and Tularæmia. In domestic animals they transmit diseases caused by *Babesia*, *Theileria*, *Anaplasma*, *Spirochæta*, *Bacteria* and Viruses.

Piroplasmosis.—The term piroplasmosis is applied to diseases caused by *Babesia* and they are all transmitted by ticks. It includes some of the most dangerous diseases which affect domestic animals all over the world. Piroplasmosis occurs in cattle, sheep, horses and dogs. In many parts of the world it is impossible to import cattle for the reason that as many as 90 per cent. may die due to this disease. The Texa or tropical red-water fever of cattle due to *B. bigemina* is responsible for the annual loss of forty to hundred million dollars every year in the United States of America. In nature it is mainly transmitted by *Boophilus annulatus*, *B. australis* and *B. decoloratus*. The other dangerous diseases due to *Babesia* are the European red-water fever due to *B. bovis* which is transmitted by *Ixodes ricinus* and *Hæmaphysalis cinnabarina* var. *punctata*, the biliary fever of horses due to *B. caballi* and *B. equi* which are transmitted by *Dermacentor reticulatus*, *Rhipicephalus evertsi* and *Hyalomma* (*Hyalomma*) *ægyptium*, and the malignant jaundice of dogs due to *B. canis* which is transmitted by *Rhipicephalus sanguineus* and *Hæmaphysalis leachi*.

Theileriosis.—One of the most formidable diseases of cattle in Africa due to *Theileria parva* is transmitted by some species of the genus *Rhipicephalus* of which *R. appendiculatus* is the most usual vector. The mortality rate due to this disease is as high as 95 to 100 per cent. A benign type of theileriosis due to *T. mutans* is widely distributed in the warmer countries of the world. Infection due to this in adult cattle proves fatal in 5 to 10 per cent. cases only.

Anaplasmosis.—This disease due to *Anaplasma marginale* is very dangerous and has a fairly wide distribution. The death rate is 95 per cent. in adults and 50 per cent. in young ones. It has been experimentally transmitted by a large number of species of ticks.

Rickettsiosis.—Among the Rickettsial diseases the Rocky Mountain spotted fever, the tick-typhus fever and Marseilles fever in man and heart-water fever of cattle, sheep and goats are well known. The Rocky Mountain spotted fever which is due to *Dermacentroxenus rickettsi* is transmitted mostly by *Dermacentor andersoni*. Tick-typhus fever in India is probably transmitted by *Dermacentor auratus* and Marseilles fever whose causative agent is *Rickettsia conori* is common on the Mediterranean Coast and is transmitted by *Rhipicephalus sanguineus*. The heart-water fever due to *Rickettsia ruminantium* is common in South Africa and is transmitted by *Amblyomma hebræum*, *Boophilus annulatus*, *B. australis*, and *Rhipicephalus capensis*.

Spirochætosis.—Some of the blood inhabiting spirochætes are transmitted by ticks. *Ornithodoros savignyi* and *Ornithodoros moubata* transmit relapsing fever in man due to *Spirochæta duttoni*. The causal agent of the Central Asiatic and Persian relapsing fever in man is *Spirochæta persica* whose chief vector is *Ornithodoros papillipes*. *Ornithodoros turicata* has been definitely proved to be connected with the transmission of relapsing fever of man in the United States. Spirochætosis of domestic fowls which is due to *Spirochæta anserina* is transmitted by *Argas persicus* all over the world.

Bacterial Diseases.—Tularæmia or rabbit fever is a disease due to *Pasteurella tularense*. It has been recorded from the United States and Japan and is primarily a disease of wild rodents but man is incidentally involved in it.

Virus Diseases.—Amongst the virus diseases the louping-ill (Macleod and Gordon, 1932) is transmitted by *Ixodes ricinus* in England, Scotland and Wales. This tick also transmits the causal agent of the "Tick-borne

fever of sheep" (Macleod and Gordon, 1933) in sheep, pigs and goats.

(*d*) *Tick Toxæmia.*—According to some observers the salivary secretion of ticks contains toxins and cases of tick paralysis in some animals and man are generally explained on the basis of their presence. Tick paralysis has been reported from the United States and Australia both in man and domestic animals. According to Regendanz and Reichenow (1931) the poison causing tick paralysis is specially formed in the female of *Rhipicephalus sanguineus* during the process of egg development. They experimentally showed that injections of eggs or ovaries of this tick just before oviposition gave rise in dogs to symptoms similar to those of tick paralysis.

The ecological studies on ticks have yielded useful results for their control. Unfavourable climatic conditions which are mainly responsible for keeping the number of ticks in check have been studied in some countries. In order that the work of extermination may be more intelligently and successfully carried out it is necessary that it should be based upon most accurate knowledge possible of the life-history, habits of the ticks and their natural enemies. Such work has been done extensively in the United States and some other countries. According to Nuttall (1913) wherever this type of work has been carried out intelligently great beneficial results have been obtained, and "large tracts of country in the United States, Australia and Africa" have "been rendered almost tick-free by these measures".

There is no doubt that ticks are comparatively free from the attacks of parasites and predaceous enemies on account of their passing a portion of their life concealed within the fur, feathers or scales of their hosts. Ticks have natural enemies both predaceous and parasitic. The study of their effects in limiting the increase of the population is being made at present in some countries.

The most efficient predaceous enemies of ticks are found among birds. The domestic fowls feed eagerly on ticks. Rats and mice feed upon ticks, and field mice assist in a limited way in destroying the engorged females. Toads, lizards and ants also feed on ticks.

Amongst the important parasitic enemies of ticks so far recorded are the Chalcids *Ixodiphagus texanus* and *Hunterellus hookeri*. The former parasite has been during recent years introduced with some success on the eastern coast of the United States of America and in Montana for the purpose of controlling ticks. The amount of money spent upon this parasite by the United States Government only increases the importance of this type of work. Specially trained persons were asked from the Laboratory of Prof. E. Brumpt in Paris to help work in America. In 1928 Dr. R. A. Cooley undertook a tour in S. Africa in order to find out the parasites of ticks. A serious attempt by highly trained persons is being made at present at Montana, where a research laboratory costing about sixty thousand dollars was specially built for this purpose in 1927. According to Cooley (1932, p. 53) for the time being the use of tick parasites appears to afford the most promising method of control.

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LETTERS TO THE EDITOR.

Dielectric Constants of Glycerides.

During recent years considerable amount of work is being carried out on the polymorphism shown by mono-, di- and tri-glycerides[1] by a thermal analysis of the melting and solidification of these glycerides. It has been shown that these glycerides exist usually in three different forms in the solid state. We have measured so far the dielectric constants of monomyristin and benzophenone at radio frequencies. The dielectric constant-temperature curves show distinct breaks giving the transition temperatures of these forms. Thus for monomyristin, Malkin and Shurbagy[2] give 56°, 67–5°, 70–5° as melting points of the different forms. In addition they get an arrest at 24°. Our measurements, likewise, confirm these and in addition, if the chilled melt of monomyristin is gradually heated to 39·5°, the dielectric constant suddenly falls from 7·77 to 3·85. This observation has been verified by carrying out the experiments at two different frequencies. Some of these forms show considerable absorption and like the dielectric constant, the temperature-absorption curves also show similar maxima and minima when the transitions take place.

In all our experiments we get a sudden break at 27° instead of 24° as mentioned by Malkin and Shurbagy (*loc. cit.*). They mention that this arrest varies within two or three degrees in different experiments. In some of our experiments this transition at 27° could not be observed accurately, but the change in dielectric absorption was quite distinct. The work is being extended to other glycerides and "liquid crystals". Our results with benzophenone are of a similar nature and confirm earlier work.

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R. D. Bhide.

Sir Parashurambhau College,
Poona,
June 17, 1938.

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Colouring Matter of Indian Tulip *(Thespasia populnea)* Flowers: Populnin and Populnetin.

Wardle[1] examined the capsules and petals of *Thespasia populnea* and found that they contained a small quantity of a yellow colouring matter soluble in water and capable of producing by the aid of suitable processes artistic though somewhat faint shades of brownish yellow and light brown on Tasar, mulberry silk and wool. He remarked that this would be a valuable dye-stuff but for the fact that the amount present was very small. A. G. Perkin[2] investigated the flowers of the allied species of *Thespasia lampas* and isolated from them quercetin and some protocatechuic acid. No work seems to have been done on the chemistry of the yellow colouring matter present in the flowers of the populnea.

A chemical examination of a small quantity of the dried petals collected in October 1933 in Coimbatore showed that they contained only a small amount of yellow colouring matter. From this was isolated as the main portion a yellow non-glycosidic pigment melting at 270–75° (I), a small amount of a yellow glycoside melting at 228–30° with decomposition (II) and a very small quantity of a third substance (III) which could be obtained pure only as its acetyl derivative melting at 182–85°. Examination of a larger quantity of the petals obtained from Trichinopoly in the summer of 1936 contained the glycoside (II) only. Compounds (I) and (II) are closely related as shown below. (III) could not be studied since the amount was too small.

The glycoside (II) which is now given the name 'populnin' has the formula $C_{20}H_{18}O_{11}$. It undergoes hydrolysis readily to yield a molecule of glucose and a crystalline aglucone (I) called 'populnetin' having the formula $(C_{14}H_8O_6)$. The aglucone forms a colourless tetra-acetyl derivative melting at 127–29°.

The following characteristics of populnin as well as of populnetin are noteworthy. They are unaffected by neutral lead acetate solutions whereas with basic lead acetate they form orange red precipitates. They give pale green colour with ferric chloride. With aqueous alkali the glucoside forms a deep yellow solution whereas the aglucone gives a red solution and both slowly fade to a pale brownish yellow. Their solutions in concentrated sulphuric acid possess a remarkable green fluorescence which disappears on the addition of water.

The constitution of populnetin is under investigation. It does not seem to be a flavone or flavonol. All its reactions indicate that it belongs to the group of hydroxy anthraquinone pigments. It is, therefore, suggested that it is a tetrahydroxyanthraquinone.

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Department of Chemistry,
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Waltair,
May 5, 1938.

[1] *Watt's Dictionary of Economic Products of India.*

[2] A. G. Perkin, *J.C.S.*, 1909, 1859.

The Coupling Phase of the Linkage Relationship between "Leaf-Sheath–Glume" and "Dry Anther-Grain" Colours in Sorghum.

IN a previous paper[1] the repulsion phase of a linkage between the factor for leaf-sheath and glume colour (Qq) and the factor for brown colour in dry anther and grain (Bb) has been recorded. The two parents figuring in that experience had the following characters. Parent (1) Reddish purple leaf-sheath and glume and no brown colour in the dry anther and no brown wash on the grain. Parent (2) Blackish purple leaf-sheath and glume and brown colour in the dry anther and brown wash on the grain. The first generation plant had reddish purple sheath and glume and brown colour in the dry anther and brown wash on the grain. In the F_2, instead of the dihybrid 9 : 3 : 3 : 1 ratio, there always occurred a 2 : 1 : 1 : 0 ratio of the double dominant and parental groups, the double recessive group being absent. The double dominants always segregated and the linkage was absolute.

In all the wild sorghums so far examined, the leaf-sheath and glume are blackish purple and the grain is brown in colour. An examination of the large collection of sorghums gathered from all over the world at the Millets Breeding Station, Coimbatore, leads to the general conclusion that broadly speaking the black-glumed groups of sorghum are mostly African in origin and the red-glumed ones predominantly Indian and Asiatic. The characteristics of the existing types of sorghum in India amply prove that there was an introduction of the African races into India and that in consequence there was free hybridisation and subsequent selection of valuable individuals. It is a matter of common knowledge that given the choice, the cattle relish fodder of sorghum plants with a reddish purple leaf-sheath in preference to those with a blackish purple leaf-sheath. The blackish purple leaf-sheath brings in its train the brown wash on the grain and this wash is an advantage to grains liable to be caught up in rains at the maturing stages. It is a matter of common experience that grains with a brown wash do not turn mouldy and discoloured so quickly as grains without the wash. The wash is therefore an asset in

any pressure necessitating the extension of the area under sorghum from favourable to partially unfavourable climatic environments. This impact between the African and Indian races of sorghum coupled with many new-place effects, must have resulted in the production of many mutants having the characteristics of both the Asiatic and African sorghums, with the result that in the course of time such mutations were spotted out and the desirable ones perpetuated as varieties of economic value. The large number of current South Indian varieties with a reddish purple leaf-sheath and a brown wash on their grain is proof to the selective influences that must have operated consequent on this impact.

As a corollary to this perpetuation of mutants having these favourable double dominant characters, the incidence and chances of perpetuation of the double recessives with their dual disabilities have also to be looked out for. In the stream of seed material passing through a breeding station, there are chances of meeting with mutants having a blackish purple leaf-sheath and no brown wash on the grain. Such a mutant was available in A.S. 1641—a chance occurrence in a cross between parents that had no wash on the grain and no black in their purple sheaths.

The availability of this mutant (A.S. 1641) helped to establish the linkage referred to above in the coupling phase. In crosses Nos. A.S. CXXXIII and CXXXIX, the double dominants and the double recessive were brought together. The details about the crosses, F_1 and subsequent generations are given in Table I.

From Table I, it will be seen that the segregation is of the simple monohybrid type, there being no off-types indicating a break in the linkage. From the data of both coupling (population 1863) and repulsion (population 9855) phases, it will be obvious that the linkage is absolute.

The many off-type varieties under cultivation in the double dominant group and the few in the double recessive group met with in a breeding station are evidently mutational in origin, the mutations being favoured by the new place effect and perpetuated according to their utility and survival value.

Crosses were effected between A.S. 1641, the double recessive and each of the three types—the one dominant, the other dominant, and the heterozygous double dominant, and also between the heterozygous double dominant and the single dominants. The results of these crosses presented in Table II conform to expectations.

TABLE I.

Leaf-sheath and glume	Reddish Purple	Blackish Purple
Dry anther	Brown	No Brown
Grain	With Brown Wash	No Brown Wash
Parents		
A.S. 349 } Cross CXXXIII	♂	
A.S. 1641 } Cross CXXXIII		♀
F_1	F_1	
A.S. 318 } Cross CXXXIX	♂	
A.S. 1641 } Cross CXXXIX		♀
F_1	F_1	
F_2 From Cross CXXXIII A.S. 3701 and 3702 } „ „ CXXXIX A.S. 3703 and 3704 }	419	128
F_3 (From A.S. 3701)		
Homozygous dominants (five families) A.S. 4432, 4437, 4440, 4443 and 4445	462	
Heterozygous dominants (fifteen families) A.S. 4426 to 4431, 4433 to 4436, 4438, 4439, 4441, 4442 and 4444	991	325
Total of segregates ..	1410	453
Expectation 3 : 1 ratio ..	1397·25	465·75
$\chi^2 = \cdot 465$ P > ·3		

TABLE II.

Cross No.	Parents		F_1 Population	Expectation %
A.S. CCIII	A.S. CXLIX	A.S. 2528	QqBb — 12	50
	(QqBb)	(qqBB)	qqBB — 10	50
,, CCIV	Do.	A.S. 817	QqBb — 13	50
		(QQbb)	QQbb — 12	50
,, CCVII	A.S. 1641	A.S. CXLIX	Qqbb — 5	50
	(qqbb)	(QqBb)	qqBb — 5	50
,, CCV	Do.	A.S. 817		
		(QQbb)	Qqbb — 33	All
,, CCVI	Do.	A.S. 2528		
		(qqBB)	qqBb — 1	All

To sum up; Most of the African races of sorghum have a blackish-purple leaf-sheath and glume, brown colour in the dry anther and a brown wash on their grain (qqBB). The Asiatic races are predominantly characterised by having a reddish purple leaf-sheath and glume, no brown colour in the dry anther and no brown wash on their grains (QQbb). There is a complete linkage between Qq (factors for leaf-sheath and glume colour) and Bb (factors for brown colour in dry anther and grain). This has been established in both the repulsion and coupling phases by suitable crosses.

G. N. RANGASWAMI AYYANGAR.
A. KUNHIKORAN NAMBIAR.
Millets Breeding Station,
Coimbatore,
June 16, 1938.

[1] *Ind. J. Agric. Sci.*, 1934, **4**, 90.

A New Phanerogamic Parasite of *Andropogon Sorghum (Jowar)*.

Andropogon Sorghum (*Jowar*) is extensively cultivated in Central and Peninsular India and parts of North India for its grain and stalk. It is a staple food crop in some parts of India and an important source of fodder to cattle wherever cultivated. Sorghum, besides being subjected to severe attack by fungi and insect pests, is also often considerably damaged due to attack by phanerogamic parasites. The only parasitic flowering plant so far recorded as attacking Sorghum belongs to the genus *Striga*. Three species of this genus all of which are root parasites are found to attack Sorghum in India. To this will now be added another of a different genus mentioned below.

Two years back the writer while collecting seeds of *Striga* species on Sorghum from different places came across a large patch of unirrigated Sorghum in a cultivator's field thickly infested with *Sopubia delphinifolia*. This field was near a village called Sutharwadi about 19 miles from Poona. It was at first thought that *S. delphinifolia* was present on the grass which had invaded the Sorghum plot. The following year *S. delphinifolia* was again observed in a Sorghum plot near a village called Aundh about five miles from Poona in a different direction to Sutharwadi. Careful examination of the root-system showed that *S. delphinifolia* was definitely attacking Sorghum by its roots establishing connection with the roots of Sorghum (Figs. 1 and 2). It was found that a single parasitic plant had its roots connected with the roots of three or four host plants. In Fig. 1 the parasite is shown attacking two Sorghum plants. At both places where *S. delphinifolia* was found on Sorghum the attack was severe and in consequence the host plants were very much dwarfed in growth.

Fyson[1] alone refers to *S. delphinifolia* as a root parasite on grass occurring usually in the open. Hooker[2] and Cooke[3] merely give the number of species belonging to the genus *Sopubia* and their distribution. Whether *S. delphinifolia* attacked plants other than uncultivated grasses was

FIG. 1.
Roots of *Sopubia delphinifolia* (B) attached to roots of *Andropogon Sorghum* (A).

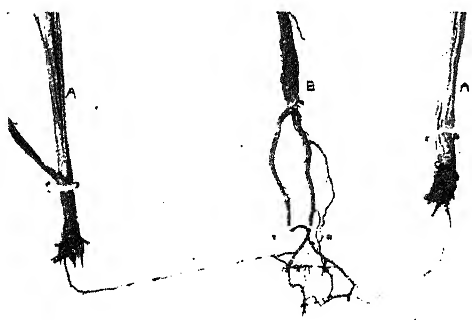

FIG. 2.
Enlargement showing the roots of *S. delphi nifolia* (B) attached to roots of *Andropogon Sorghum* (A).

uncertain until it was observed to attack Sorghum.

The writer has not been able to find any reference to previous report of *S. delphinifolia* attacking Sorghum and this is the first instance of its being placed on record.

L. S. S. KUMAR.

College of Agriculture, Poona,
June 21, 1938.

[1] Fyson, P. F., *Flora of the Nilgiri and Pulney Hill-tops*, 1915, **1**.
[2] Hooker, J. D., *The Flora of British India*, 1885, **4**.
[3] Cooke, Theodore, *Flora of the Presidency of Bombay*, 1903, **2**, Part II.

The Occurrence of Root-Hairs on Aerial Roots in Sorghum.

DURING 1937–38, the Type-1 Sorghum (*S. cernuum*, Host.) crop on the Station was very much stunted due to deficient rainfall. To understand the effect of drought on the development of the plant, root-studies were undertaken. When the plants were two months old (Nov.–Dec.), the aerial adventitious roots arising from the bottom nodes were found to be trailing along the ground instead of penetrating it as a result of a very hard top layer of soil. These had a silvery, woolly look instead of being green. Microscopic examination showed this to be due to light reflected by innumerable, transparent root-hairs jutting from the epidermis. The root-hairs were distributed *all over the surface* of the aerial root. Normally in the Sorghum plant, the aerial adventitious roots are devoid of root-hairs. Root-hairs develop only when these aerial roots pierce the ground and come into contact with the moist particles of soil. Even when the root-hairs are present they are usually confined to a short distance behind the root tip in the tender undifferentiated tissues. The occurrence of numerous root-hairs all over the root, which is entirely aerial, in the natural field environment is, so far as we are aware, rare. Further, the root-haris on these roots were healthy and full of protoplasmic contents. At the time of observation (Nov.–Dec.) the atmosphere was very dry except for a small amount of dew in the early hours of the morning. As these aerial adventitious roots could not penetrate the hard layer but remained trailing along the surface without coming into contact with moist soil, the only logical explanation for the occurrence of root-hairs on the surfaces of these aerial roots seems to be that they were developed there in response to the dew. The nature of root-hairs themselves, *viz.*, their perpendicular disposition with straight cell walls lends further support for the suggestion that they were developed in response to moisture.[1]

This unusual development of root-hairs strongly suggests the extreme efforts on the part of the plant at obtaining water which it so badly needed during this particularly dry season.

C. VIJAYARAGHAVAN.
V. PANDURANGA RAO.

Agricultural Research Station, Hagari,
May 20, 1938.

[1] F. Schwarz, *Untersuch. Bot. Inst. Tübingen*, 1883, **1**, 135–88.

Gynura crepidioides Bth.—A Recently Introduced Weed in S.E. Asia.

As far as I am aware this Gynura has been only mentioned for S.E. Asia in the Suppl. (6th Vol.) of the *Handbook of the Flora of Ceylon* by Alston in 1931. He says of it: "Recently introduced but now a very common weed in cultivated ground in Ceylon." In Netherlands India it must have been introduced into Sumatra (East-coast Residency) about the same time, *viz.*, in the year 1926. Jochems[1] reported it for the first time from the vicinity of Medan. Probably it has found its way from Africa, where it is indigenous, to Ceylon and from there to Sumatra. In a few years it has spread over the whole of Sumatra and Java; in the latter island it has been purposely introduced from Sumatra by tea-planters. It is astonishingly common and is now far more common than *Erechthites valerianifolia* and *E. hieracifolia* together, which were introduced at a much earlier date in the nineteenth century. Its dispersal rapidity is quite astonishing and is not surpassed by any other introduced weed; single plants are found along paths and in clearings at remote places. It occurs from sea-level up to more than 3,000 m. altitude. A history of its dispersal I have given elsewhere.[2] It has now reached also the S. corner of Celebes.[3]

From both species of Erechthites mentioned above it can be easily distinguished by its drooping, red-brown heads.

The first record from the main land of S.E. Asia is, as far as I am aware, a plant found in Southern Annam, in the vicinity of Dalat, of which the Buitenzorg Herbarium received a duplicate, distributed under the name *Erechthites hieracifolia*, collected by Mr. R. W. Squires, No. 797, March-April 1932, on a sandy river bank. The identification is wrong, the specimen belongs to the said *Gynura crepidioides* Bth. I am sure that the plant is rapidly spreading in S.E. Asia and this note is intended to attract the attention to this remarkably eurytopic weed.

C. G. G. J. VAN STEENIS.

The Herbarium, Botanic
Gardens, Buitenzorg, Java, N.E.I.
June 18, 1938.

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1 *Trop. Natuur*, 1931, **20**, 5.
2 *Natuurk. Tijdschr. Ned. Ind.*, 1936, **96**, 132.
3 *Trop. Natuur*, 1938, **27**, 95.

The Distribution of Krishna Iyer's "Mean of Fisher's t^2".

MR. P. V. KRISHNA IYER has published a rejoinder[3] to my comments[2] on his paper "The Distribution of the Mean of Fisher's t^2 for Samples from a Normal Population".[1] Referring to the distribution of $\bar{t}^2$ in the case of samples of unequal sizes Mr. Iyer states in the last sentence of his reply: "The distribution of this mean, as it involves only $(p-1)$ independent comparisons can be taken to be the one shown in the paper", and in fact the whole point in his argument lies in this sentence. Unfortunately this statement is incorrect as can be easily proved.

Let me begin by re-stating the problem. We have p samples of sizes: $n_1, n_2, \cdots, n_p$, and means: $\bar{x}_1, \bar{x}_2, \cdots, \bar{x}_p$, respectively, coming from an unknown normal population. Let s_1^2 denote the variance estimated from 'within samples' with $N - p$ degrees of freedom, where $N = n_1 + n_2 + \cdots + n_p$.

Mr. Iyer considers the expression

$$\frac{2}{p\,(p-1)} \cdot \frac{1}{s_1^2} \cdot \sum_{s=1}^{p-1} \sum_{r=s+1}^{p} \frac{(\bar{x}_r - \bar{x}_s)^2}{\frac{1}{n_r} + \frac{1}{n_s}} \quad .. \quad (1)$$

which is the mean of all $[\frac{1}{2}\,p\,(p-1)$ in number$]$ t^2's that can be formed, and denotes it by $\bar{t}^2$. Writing Fisher's 'Ratio of Variances' as w we have

$$w = \frac{\sum_{i=1}^{p} n_i\,(\bar{x}_i - \bar{x})^2}{(p-1)\,s_1^2}, \text{ where } \bar{x} = \frac{\sum_{i=1}^{p} n_i\,\bar{x}_i}{N} \quad . \quad (2)$$

The distribution of w is known to be

$$\text{Const.}\ \frac{w^{\frac{p-3}{2}}\,dw}{[(N-p)+(p-1)\,w]^{\frac{N-1}{2}}} \quad .. \quad (3)$$

It can easily be seen that $\bar{t}^2$ is identical to w when $n_1 = n_2 = \cdots = n_p$ and not otherwise. The distribution of $\bar{t}^2$ can be derived from that of w only in this case of equal-sized samples. But Mr. Iyer believes that the $\bar{t}^2$ of the 'unequal case' has the same distribution as $\bar{t}^2$ of the 'equal case', that is to say, the distribution in the former case is same as (3).

Without troubling about the distribution of so cumbrous an expression as (1) it will be enough if we consider the first two moments of (1) given below:—

$$\left.\begin{aligned}\mu_1(\bar{t}^2) &= \frac{N-p}{N-p-2}\\ \mu_2(\bar{t}^2) &= \frac{2(N-p)^2}{(N-p-2)(N-p-4)}\left\{\frac{N-p-1}{N-p-2} - \frac{(p+1)(p-2)}{p(p-1)}\right.\\ &\qquad\left. + \frac{8}{p^2(p-1)^2}\,\Sigma\,\frac{n_j\,n_k}{(n_i+n_j)(n_i+n_k)}\right\}\end{aligned}\right] \quad (4)$$

where Σ is taken over all values from 1 to p of i, j, k in such a way that $i \neq j \neq k$.

From (3), on the other hand, we easily get :—

$$\left.\begin{aligned}\mu_1(w) &= \frac{N-p}{N-p-2}\\ \mu_2(w) &= \frac{2(N-3)}{(p-1)(N-p-4)}\cdot\left(\frac{N-p}{N-p-2}\right)^2\end{aligned}\right] \quad (5)$$

Comparing (4) and (5) we find that though the first moments agree, the second moments of $\bar{t}^2$ and w are entirely different. There can now be no doubt that the distribution of (1) is different from (3). [It may be noticed, however, that if we put $n_1 = n_2 = \cdots = n_p$ in (4) the two second moments coincide; this is as it ought to be because in this case $\bar{t}^2 \equiv w$.]

I can now recall my comments : "Mr. Iyer does not appear to have realised that nothing is known about the sampling distribution of what he calls $\bar{t}^2$ in the case of unequal observations. It is therefore absolutely useless for purposes of tests of significance."

K. Raghavan Nair.

Statistical Laboratory,
Presidency College,
Calcutta,
May 10, 1938.

[1] *Proc. Ind. Acad. Sci.*, (A), 1937, **5**, 528.
[2] *Curr. Sci.*, 1937, **6**, 290.
[3] *Ibid.*, 1938, **6**, 392.

Derris ferruginea Benth from Assam.

It was reported,[1] in a previous article entitled "Occurrence of *D. elliptica* in India", that a species of Derris, at that time believed to be *D. elliptica*, was found in the plains of Assam. Later on, doubts arose as to its correct identity and consequently the matter was reinvestigated, with the result that the so-called *D. elliptica* of Assam has now definitely been established as *D. ferruginea* Benth (Kew concurring). These findings negative the occurrence of *D. elliptica* in India. The analytical results given previously, therefore, refer to *D. ferruginea* and are of additional interest in so far that the occurrence of rotenone in this species has not been recorded before.

This Indian species of wild Derris is sufficiently rich in rotenone (nearly 3 per cent.) and can be of value as an insecticide, both for home consumption and export purposes. Its distribution in Assam is, therefore, being published for the benefit of those interested in the commercial exploitation of this important vegetable insecticide.

Forest Division	*Localities*
Sibsagar ..	Kamalabari, Bakuba and Dikumer
Nowgong ..	Doboka Reserve
Lakhimpur ..	Elemgmora, Bartagaon, Panigoa Reserve
Khasi and Jaintia Hills ..	Umsaw
Goalpara ..	Haltugaon
Darrang ..	Charduar

S. Krishnan.
T. P. Ghose.

Forest Research Institute,
Dehra Dun,
June 29, 1938.

[1] *Curr. Sci.*, 1936, **4**, 857.

REVIEWS.

Progress of Science in India.—The Progress of Science in India during the past Twenty-Five Years. Edited by B. Prashad. (Published by the Indian Science Congress Association, Calcutta.) Pp. lvi + 767. Price Rs. 5 (Paper Cover); Rs. 6 (Bound).

During the last quarter of a century there has been a remarkable progress as regards scientific teaching and research in all parts of India. This period has synchronized with the foundation and growth of the Indian Science Congress, which celebrated its Silver Jubilee in the earlier part of the year. It was therefore a happy thought on the part of the authorities of the Science Congress to have undertaken the task of publishing the volume under review. The volume has been brought out with commendable promptitude under the general editorship of Dr. B. Prashad, Director, Zoological Survey of India. Besides a valuable introductory chapter by the editor, it contains 17 other chapters written by the specialists in their respective fields. The various chapters have been contributed by Dr. W. A. Jenkins (Scientific Education), Principal B. M. Sen (Mathematics), Prof. J. C. Ghosh (Chemistry), Mr. D.N. Wadia (Geology and Geography), Dr. W. Burns (Agriculture), Mr. F. Ware (Veterinary), Mr. Z. L. Kothavalla (Dairy Husbandry), Rao Bahadur K. N. Dikshit (Archæology), Dr. B. S. Guha (Anthropology), Dr. G. Bose (Psychology), Dr. H. Srinivasa Rao (Zoology), Mr. H. G. Champion (Forestry), Mr. W. C. Ash (Engineering), Lieut.-Col. S. L. Bhatia (Physiology), Sir U. N. Brahmachari (Medical), Prof. M. N. Saha (Physics) and Prof. S. P. Agharkar (Botany).

It will be seen from the above that the list of contributors includes some of our leading authorities and their names are a guarantee of the high quality of their work. All the contributors have taken pains to present full and useful summaries of the work done in their respective fields. An examination of the book in detail shows that not only has full justice been done to the high lights in Science, such as Bose, Ray, Ramanujan, Raman, Saha and Sahni, but the work of the humble camp followers has also been duly noticed. Most of the chapters are provided with useful bibliographies. The book is a mine of useful information relating to the achievements of Indian scientists and is sure to prove a *vade-mecum* to all scientific workers.

The editor and the contributors deserve to be warmly congratulated on their cooperative effort in producing such a highly useful volume.

B. L. B.

The Adrenal Cortex and Intersexuality. By L. R. Broster, Clifford Allen, H. W. C. Vines, Jocelyn Patterson, Alan W. Greenwood, G. F. Marrian and G. C. Butler. With a Foreword by Sir Water Langdon-Brown. (Chapman and Hall, Ltd., London), 1938. Pp. xii + 245. Price 15*s*. net.

The book is undoubtedly a solid contribution, extending our knowledge of some of the obscure biological phenomena resulting in distressing manifestations, such as feminine virilism, masculine feminism, absence or disppearance of procreative instincts in either sex, and the failure of development of genital organs to their functional proportion. These vagaries of human nature provide a field for investigation far beyond the compass of a single study, and therefore the problem has been approached from the clinical and surgical, psychological, pathological and biochemical aspects. The whole subject, till the researches of Dr. H. W. C. Vines were made known, was surrounded by speculative controversies, and the demonstration of the presence of a specific substance, strongly fuchsinophil, in the adreno-cortical cells of patients afflicted with virilism, rendered progress along other lines of investigation possible and rapid. Any departure from normal development, apart from the distress caused to the unfortunate victims, must have a far-reaching effect on social problems, and therefore the interest of the book is not confined to the medical profession, but must necessarily extend to the community in general.

The book is divided into two parts. The first part is devoted to the clinical study

of the adreno-genital syndrome under clinical and surgical, and psychological aspects and the second part deals with the scientific study of the adreno-genital syndrome under pathological and biochemical aspects.

The results obtained under each head point to the existence of a chain of physiological links connecting the hypothalamus, pituitary, suprarenal and sex glands, and any departure in the function of any one of the first three structures, produces imbalance of the last and the consequent abnormal manifestations. Normal development and functions must therefore depend upon the maintenance of the balance of physiological power among these co-ordinating endocrine bodies, and hyperplasia or hypersecretion of any one of them leads to distressing alterations of the psychosomatic organisation. These maladies are therefore capable of being terminated by surgical and psychological treatment.

In the case of female virilism Dr. Broster, who has given a complete account of his technique and results of unilateral adrenalectomy, has established that "the surgery of the adrenal gland in virilism coincides with our conceptions of the other glands in the endocrine series, that a hypersecretion of the two glands can be controlled by means of the removal of one, and there is as yet no clinical evidence that the remaining gland hypertrophies sufficiently to cause a return of the condition". The results of operation have been to restore the patients to the normal feminine characters with the return of the capacity for sexual life.

The phenomenon of intersexuality has a profound biological significance. The determination of sex is only a pattern of chromosomal endowment, on which the pituitro-adrenal mechanism has a direct control. The physical side of the individual sexuality is as complicated as the psychical side, because the seat of emotions—hypothalamus—is closely connected with one of the most important glands—the pituitary body. Dr. Allen who has investigated cases of perversions which form the body of adreno-genital syndrome, and who has pursued a new line of enquiry, has achieved important results by showing the close relationship of the psychic element with physical abnormality. Dr. Broster's patients have been psychologically studied by Dr. Allen and the table and description of cases (pp. 74–131) show the dependence of sexuality on endocrine and psychic factors—glandular dysfunction producing mental maldevelopment.

Perhaps Dr. Vines's histological investigation of the adrenal cortical tissue (an account of the Ponceau-Fuchsin Stain method adopted by him found on pp. 139–40) of all the cases of virilism, has given us a rare insight into the ætiology of aberrations. The results of pathological investigations have led to the enunciation of the general principle "that the occurrence during the early fœtal life of the female of a short period of androgenic and heterosexual development of cortical origin introduces an element of instability which is rare in the male. Further study led to the suggestion that in normal development, the adrenal cortex plays the part of bisexual accessory sex gland which is active throughout life, and that it secretes both androgenic and œstrogenic harmones under the control of the pituitary". Perhaps the next step in the investigation will be to incriminate the sympathetic system in the production of the abnormal sexual variations of the kind of intersexuality. The biochemical investigations of Dr. Patterson and Professor Marrian have shown the occurrence of 'free' and 'bound' male harmone in the urine of the patients, and to the isolation of a new substance, peregnane 3–17–20 triol ($C_{21}H_{36}O_3$) from the urine of typical virilism cases.

The book is profoundly interesting and important. Its chief merit lies in opening up new fields of investigation in a branch of knowledge, to which the contributions of the authors will always remain permanent and inspiring.

Season of Birth, its Relation to Human Abilities. By Ellsworth Huntington. (John Wiley & Sons, New York; Chapman & Hall, Ltd., London), 1938. Pp. vii + 473. Price 17/6.

The book attempts to establish the foundations of a new branch of science, "Climatological Basis of Human Progress" and for this purpose the author, who has done considerable investigation in statistics, assures the readers that he has discovered a new theory of far-reaching importance. The statistics reveal a close relationship of birth and climate, and it is possible for climatic conditions to influence the path of human progress. It is pointed out that the human species during the ice age

acquired a mechanism of adjustment to climatic changes and this mechanism having a survival value must have determined the reproductive periods. The author deduces from his researches that the sexual rhythm coincides with what he calls the physical and mental optimum temperatures, the former favouring conception and the latter promoting the health and longevity of the new-born infants. Attempts to establish favourable months for the birth of geniuses (January, February or March) from an exhaustive study of their dates of birth, have also shown that during these months an equal number of idiots and imbeciles were born. The study of school children in America shows that children born in September and October have a comparatively higher I.Q. than those born at other seasons, the I.Q. being lowest in the case of those born in January and February. According to the author who has gathered his statistics from American archives, the physical optimum temperature is the average of 60° to 65° F. and the mental optimum temperature is the average of 39° to 54°F. Having established these two mean temperatures, he proceeds to elaborate his thesis that it is the most favourable temperature to promote the general metabolic activity and glandular function. It is noted that the brain does not function as well as other organs at certain temperatures and the optimum of the latter may not be the optimum of the former. The author has an explanation for this apparent anomaly.

In the case of lower animals the periods of vegetative and reproductive functions follow a cycle which closely synchronises with the seasonal cycle. These periods depend upon the presence and abundance of food, freedom from enemies, the reaction of the nutritive phase on the liberation of sex harmones and the emotional impulses leading to sex congregation. Perhaps the subhuman races and primitive man of the glacial epoch must have been subject to the laws which still govern the vegetative and reproductive phases of animals, but how far is the modern American gentleman removed from his remote ancestor,—in the matter of food, dress, tastes, habits, and the progress of this gentleman has been rendered possible by his success in the efforts to control his natural environment. He is at present engaged in creating artificial climates, so as to secure comfort and health, independently of the natural cycles. Man's conquest over nature has been a triumph of his mind. Assuming that temperature has a profound influence on glandular activity and that there are definite seasons for conception and birth in human society, it must be remembered that the temperature conditions (including humidity and sun light) which governed the metabolism and reproduction of primitive man are totally different from those prevailing in a Modern City like New York or London. What is the effect of the presence of dust, odours and poisonous gases on the temperature of the air? What about the great irrigation projects and the policy of deforestation?

Apart from all this, we know that conception in the case of animals follows the onset of menstruation,—a phenomenon which has definite periods, separated by long intervals. These intervals among men are abridged to less than a month and recurrence of such periods involves the natural consequences. In the animals the coincidence of the appearance of heat with a particular season, would seem accidental and in man the periods occur normally throughout the year. If the greatest number of births should occur in particular months, can it be supposed that the optimum physical and mental temperatures have determined the number or that seasons exercise some mysterious effect on the birth of geniuses and idiots? Is it supposed that a certain season favours the fusion of germinal cells more effectively than another when germinal cells are available throughout the year for impregnation?

We are not disposed to question or minimise the influence of climatic conditions on human birth rate, but we should imagine that these conditions alone cannot offer a satisfactory explanation of phenomena such as the greatest number of births in particular months or the appearance of the largest number of eminent men or mental deficients in certain seasons. They depend upon other biological factors for the optima of one nation may not be the optima of another and the physical and mental optimum temperatures of the author cannot have universal validity. The influence of climate on the reproductive activities of animals is exerted indirectly through the production of proper and adequate food supply and as civilisation progresses, the

share that temperature had in shaping the procreative phase of primitive man must necessarily diminish.

We may not agree with all the arguments of the author in supporting his theory which is certainly entitled to respect. The author does not entirely depend upon statistics for its formulation. We have no doubt that the book will be widely read. Its doctrine is stimulating and novel, perhaps daring in its originality, but throughout the author conforms to the logical method of developing his propositions. When researches on these lines are undertaken in other countries, perhaps the theory of optimum temperatures in relation to births may become a scientific generalization.

Physics in Industry: Magnetism. (London: The Institute of Physics. Published by the Physical Society, London), 1938. Pp. 102. Price 4*sh*. 10*d*.

During the past several summers, the Manchester and District Branch of the Institute of Physics has been arranging conferences on important problems involving application of physics in industry. A branch of physics in which rapid progress has been made is usually chosen and a series of talks is arranged from those well qualified to speak with authority. An account is given in this book of the conference on 'Magnetism,' held in July last year in Manchester.

As Prof. W. L. Bragg aptly remarks in his Foreword, magnetism is a particularly suitable subject for discussion. The interests aroused by this subject are extensive and offer a close link between the universities on one side and industry on the other.

The book contains the summaries of six principal lectures delivered during the Conference. In the first lecture, Prof. Mott deals with the electron theory of magnetism. A brief qualitative explanation of the Brillouin zone theory is offered and the conditions for ferromagnetism are deduced. The next lecture by Mr. Richer of Messrs. John Lysaght, Ltd., Newport, deals with the difficulties in the attainment of magnetic saturation with electrical sheet steel. The hysteresis losses in silicon steel due to the presence of small quantities of carbon and sulphur and also due to eddy currents and grain boundaries are outlined and the possibility of further improvements in the magnetic performance of electrical sheet material is considered. Dr. Dannatt of the Metropolitan Vickers Electrical Co., Ltd., presents in the third lecture, a clear and concise account of the influence of magnetic materials on the design of power plant. In the fourth lecture, Dr. Stoner summarizes the main characteristics of the magnetization curves of ferromagnetic materials. Mr. Oliver of the Permanent Magnet Association, Sheffield, gives in the next lecture a summary of recent work on permanent magnets which are in such great demand to-day in the radio industry and in the construction of electrical measuring instruments. In the last lecture, Dr. Bradley and Dr. Taylor deal with the relation between atomic arrangement and magnetic properties. X-Ray studies on Prof. Mishima's new alloy Fe_2NiAl show that its remarkable magnetic properties are obtained only when the molten alloy is cooled at such a rate that the iron atoms are held apart from joining together to form islands.

On perusing the book, one cannot help recording a feeling of admiration towards the Japanese investigators working under the inspiration and guidance of Prof. Honda for their extensive and valuable research on the ferromagnetism of metals.

Great credit is due to Dr. Sykes for the able manner in which he has edited the series.

S. R. R.

Spectroscopy in Science and Industry. Proceedings of the Fifth Summer Conference on Spectroscopy and its Applications. (Chapman & Hall, Ltd., London), 1938. Pp. vii + 134. Price 1 *sh*.

The publication under review is a compilation of twenty-nine papers that have been presented before the conference on Spectroscopy and its Applications, held during July 1937 at the Massachusetts Institute of Technology. Some of the papers are followed by abstracts of discussions. The papers deal with applications of spectroscopy to a variety of subjects such as experimental technique; analysis of samples of iron, steel, caustic liquors, skin, urine, pigments and gland secretions; structure determinations; rates of reaction; equilibrium in gaseous systems, light sensitivity in seeds and plants, etc. Ten of these papers are mainly concerned with the problems relating to the technique to be adopted and the accessories required in a laboratory of applied spectroscopy. Four papers are devoted to the analysis of samples of iron and steel. Most

of the other papers deal with the possibilities of utilising spectroscopic methods as tools for solving some biological and physiological problems.

S. BHAGAVANTAM.

Outlines of Methods of Chemical Analysis. By G. E. F. Lundell and James Irwin Hoffman. (John Wiley & Sons, Inc. New York, Chapman & Hall, Ltd., London), 1938. Pp. xi+250. Price 15*sh.*

This book is intended to be a companion volume to Hillebrand and Lundell's well-known treatise *Applied Inorganic Analysis.* The authors have endeavoured to present systematic methods of chemical separations and analysis rather than the determinations of elements when they occur alone.

The first part consists of three chapters dealing with the occurrence of elements and their classification. Adequate reference is also made to the composition of the well-known minerals and also of the ceramic, ferrous and non-ferrous materials.

The second part covers all the important methods for separating the elements. In the reviewer's opinion, this is the most valuable portion of the book as it presents at a glance all the facts in a most impressive manner.

The third part deals with methods for determining the elements which include the usual gravimetric methods employing inorganic and organic reagents as well as volumetric methods based on (1) acidimetry and alkalimetry, (2) oxidation and reduction, (3) iodimetry and iodometry. Potentiometry, electrolytic methods, colorimetry and spectrochemical methods are also briefly described.

The fourth part presents diagrammatic outlines of methods of analysis of commercial materials such as limestone, feldspar, bauxite, steel, brass, bronze, etc.

The fifth and the last part deals with the evaluation of the accuracy and precision of the results obtained during analysis.

This book is a very valuable addition to the existing text-books on analytical chemistry and it can be most heartily recommended to every one interested in the subject.

K. R. K.

Direct and Alternating Current Potentiometer Measurements. By D. C. Gall, (Messrs. Chapman & Hall, Ltd., London), 1938. Pp. xiv + 231. Price 15*sh.* net.

This book forms the fourth volume of a series of monographs on Electrical Engineering edited by H. P. Young. There is a Foreword by S. P. Smith.

The first five chapters are devoted to the description and use of the D.C. potentiometer. The sixth chapter deals with the polar types of A.C. potentiometer and the seventh with the co-ordinate type of A.C. potentiometer devised by the author. A description is given of the circuit and its components and the methods of standardisation and phase splitting. Methods of setting up and using the instrument are described together with precautions to be taken. The effects of harmonics, stray magnetic fields and variation of frequency are mentioned. The next four chapters deal with the uses of the A.C. potentiometer. Calibration of ammeters, voltmeters and wattmeters is dealt with. Description is given of the methods of measuring iron-losses, mutual impedance, ratio and phase angle errors of current and potential transformers and the distribution of potential in geophysical prospecting. The twelfth chapter deals with the factors governing the choice of a potentiometer circuit. Effects of leakage, stray capacitance and magnetic fields are discussed and methods of eliminating these effects are suggested. The next chapter deals with the representation of alternating currents by complex quantities and the book ends with a historical note on potentiometers.

The book is immensely useful to those engaged on potentiometry. Difficulties encountered in using the A.C. potentiometer are well brought out, possible sources of error are mentioned and methods of eliminating these are indicated.

B. J. B.

Colloid Chemistry—Principles and Applications. By Jerome Alexander. (Chapman & Hall, Ltd., London), 1937. Fourth Edition. Pp. xviii + 505. Price 22/-.

The book under review is the enlarged edition of the author's well-known book that appeared nearly a decade ago. Its well-merited polpularity is as much due to the able manner in which the subject-matter is presented as to the wide range of subjects it envisages. Every student of chemistry

knows that the ramifications of colloid chemistry are wide but even the most versatile among them has to study the pages of Alexander's *Colloid Chemistry*, to ascertain for himself how wide they are.

The first 8 chapters deal with the general principles of colloid chemistry and include classification, preparation and properties of colloids. Under practical applications, covering some 8 chapters and 140 pages, the author has dealt with a variety of subjects including chemical warfare and confectionary and the eminently readable manner in which the facts are presented makes the book at once interesting and valuable. Chapters 17–23 deal with the rôle of colloids in biology and medicine. The presentation of the subject in these chapters is even more fascinating. The chapter on Genetics (Chapter 19) will do credit to any text-book on the subject. One hardly realises that he is reading a book on colloids until the question of factors influencing development is taken up for discussion !!

Books of this type are rare and for the general reader, the book presents a wealth of information which he can gather without much exertion. The study provides a liberal education and the book is recommended to the University student who is generally text-book minded and often is prone to overlook the fact that mental barriers arising from scientific specialisation, are only artificial. The book is particularly recommended to teachers who will find in it a logical presentation of experimental facts. Adequate emphasis is laid on the application of the principles of colloid chemistry in the fields of pure science and technology.

The Travancore Tribes and Castes, Vol. I. By L. A. Krishna Iyer, M.A. (Government Press, Trivandrum), 1937. Pp. xxi + 277. Price Rs. 7.

This book contains survey accounts of seven of the backward tribes or communities of Travancore State. They are the Kanikkar, Malankuravan, Malapantaram, Malapulayan, Malayarayan, Malavedan and Mannan. The prefix, *Mala* (hill), is found in the names of five of the tribes, but why it does not occur with the names of the other two seems to be an intriguing question. In dress and in speech some of the tribes appear to be of Tamil extraction, and this inference is supported by their tribal myths and traditions, but as in other regions of the Ghat area, there is here also the superimposition of Kerala culture on the simpler culture of the tribes proceeding at a rapid pace along with the economic penetration of the people of the low country into the territory of the "kings of the forest". How the less differentiated tribal culture reacts to the newly introduced influences is, of course, the chief point of theoretical as well as practical importance in this study. On the administrative side, the tribes present a difficult problem but the author has made it clear that uncontrolled changes and contacts with 'civilization' are not in the interests of the Travancore tribes as of other backward communities in other parts of the world. It is however gratifying to learn that many of the tribes are increasing in numbers and are getting Hinduised. Dr. J. H. Cousins who contributes a preface hopes that these tribes will also benefit, at least psychologically if not in a more direct manner, by the temple entry proclamation of H. H. the Maharaja of Travancore.

The author has presented his data at the observational level in the manner of the ethnographic survey volumes published for the British Indian provinces over three decades ago. The ethnographic material published in this volume will provide the basis for detailed analytical studies of the tribes, which, we hope, the author will undertake.

A. AIYAPPAN.

Le Nutrition, Parts iii, iv, v, vi and vii. (Actualites Scientifiques et Industrielles. Nos. 557–561, Herman et Cie, Paris.)

(1) **Le Soja et Son Role Alimentaire.** By Jean Bordas. Pp. 32. Price 8 *fr*.

(2) **L'Utilisation Alimentaire de La Cellulose.** By M. Mangold. Pp. 38. Price 8 *fr*.

(3) **Le Probleme du Pain—Les methodes d' Appreciation de la Valeur Boulangere Des Farines et des Bles.** By Raymond Guillemet. Pp. 60. Price 12 *fr*.

(4) **Le Probleme du Pain—La Fermentation Panaire.** By Raymond Guillemet. Pp. 100. Price 20 *fr*.

(5) **La Consideration du Poids Vif Dans Les Etudes d'Alimentation.** By Raoul Gouin. Pp. 23. Price 7 *fr*.

Of these short monographs on subjects connected with nutrition the one on the soya bean will be of most interest to Indian

workers. The author gives full chemical analysis of many varieties and discusses the ways in which the pulse may be used as a food for both men and animals. The total production in various countries of the world is given. It is pointed out that the soya-bean is not cultivated widely either in France or in the French Colonies, and it is suggested that its extended use should be considered by all local Agricultural Research Stations.

R. P.

An Introduction to Geology. By A. E. Trueman, D.Sc., F.G.S. (Thomas Murby & Co., London), 1938. Pp. xvi + 258. Price 4*s*. net.

A Committee of the British Association recently discussed the place of Geology in a scheme of education for the young, and the claims of the subject for being included in all school courses either as an independent subject, or as part of a scheme of instruction in 'General Science', or in connection with courses in Geography, have been eloquently and convincingly set forth in their Reports. Accordingly quite a number of schools in England have already introduced Geology in their courses, and there is no doubt that many more will soon follow. We hope it will not be long before the educational authorities in India will also adopt the recommendation of the British Association Committee and give Geology its proper place in our scheme of scientific education; for "involving as it does long excursions into space and time, Geology is a subject peculiarly fitted to stimulate scientific imagination, which is the very essence of the highest education".

The present *Introduction to Geology*, by Prof. A. E. Trueman, has been prepared on the lines approved by the British Association Committee, and is intended for the young High School student who is just beginning to learn Geology. In the course of about 250 pages, the book deals in an elementary way with the whole range of the subject. The illustrations are mostly diagrammatic; but considering that the book is meant for the young student who is just being introduced to the subject, this is certainly an advantage, since such diagrams can be made to illustrate very clearly the geological phenomena, which it is intended the young reader should properly understand. The treatment of the subject-matter is throughout exceedingly clear and lucid, and the suggestions for Practical Work given at the end of each chapter form a very valuable feature of the book, and will greatly assist the teacher in making the subject more interesting and popular. On the whole, the book serves to give an excellent 'introduction' to Geology, not only to the young student who may later proceed to specialise in the subject, but also to the general reader who desires to know the scope and methods of Geology, as a science.

L. Rama Rao.

Biology for Senior Schools—Book I. By M. R. Lambert. (Macmillan & Co., Ltd., London), 1937. Pp. 158. Price Re. 1-10-0 or 2*sh*. 9*d*.

With the realisation of the fact that the essentials of Biology form an integral part of the training of every child, a large number of books have come to be written for the use and guidance of children. The book under review intended for an eleven-year old child is the first of a series of three and the portions included in it are expected to be covered in a year. A refreshingly novel method of introducing the subject is used, the child being asked in the first few pages to make the acquaintance of a familiar plant and an animal. The examples chosen, the dog and the butter cup are essentially those with which the English child is more familiar and the author, instead of plunging directly into technical lore regarding the differences between plants and animals in the first chapter of the book as is common in most books on Biology, gently takes the child through everything that a plant or an animal does and finally reveals to the eager mind the important characters of the two groups of living beings. This essential fact of good teaching—from the familiar to the unfamiliar—is seen throughout the book and is the outcome of the experience of an actual teacher, which the author is. The introduction of a few simple but highly convincing experiments help to sustain the interest of the child throughout. The examples of the plants and animals chosen are such as to make the book useful to English children and it leaves behind a desire for a similar book for use in Indian schools.

B. R. S.

Erosion and Soil Conservation.*

GREAT BRITAIN is one of the few parts of the world where accelerated soil erosion is not of first class importance in land management. Elsewhere the uneven distribution of rainfall and the severity of sudden storms, falling on any land whose surface has been laid bare by the destruction of the natural plant cover, cause the surface soil to be washed away. If this goes on unchecked it is later followed by the formation of gullies which cut deep into the higher ground, and in time the natural level of the underground water-table is disturbed because of these newly dug channels draining the land to a deeper level. Blocks of land are thus left isolated by the spread of gullies, and these plateaux are in time reduced and cut away by the accelerated run-off from their own surfaces.

Erosion of this type is not confined to countries of heavy rainfall, in fact the damage is most severe when storms come at long intervals between periods of drought, because under such conditions nature can produce only a thin covering of plants, whereas with a better distributed rainfall the plant cover is denser and protects the soil more effectively. Herein lies the secret of the British Isles' immunity from serious erosion danger.

Because this problem is not of any great importance in their homeland, soil scientists and land workers trained in Britain have probably been slow to recognise the symptoms of this condition in other countries, but soil scientists and forestry officers in many of the colonies and dependencies of the Empire have been wrestling with soil erosion in various forms for many years past. They were inclined to treat them as purely local problems until they realised that workers in many other countries were confronted with very similar conditions. Since the formation by the Federal Government of a Soil Conservation Service in 1933, American experience has produced a large amount of written matter dealing with both wind and water erosion. This is ably summarised in the book under review in a space of 50 pages, and the remaining 150 pages are devoted to shorter summaries for all the other countries for which reliable information was forthcoming. It is therefore of great value in bringing up-to-date our knowledge of countries such as South and East Africa, Australia, and Ceylon, about which Indian workers already have some information. It is even more useful in giving us a picture of the condition in other countries for which information is not so readily available, such as Russia, Italy, Turkey and China.

The summary for India is naturally the one which interests us most. In the space of 9 pages a very fair statement of the erosion problem, its prevalence in the various provinces, its disastrous consequences to the rural population, the painfully few attempts so far made to meet the situation, and the various proposals put forward by specialists who recommend more drastic action. For the benefit of many who are frightened at the heavy expenditure which they imagine is inevitable, the following is quoted:

"No remedy is likely to succeed without careful education and instruction of the Indian cultivators in better farming, particularly terracing, and in the care and feeding of cattle. Practical demonstration would involve very considerable financial assistance from governments. On the other hand, the proper control of grazing grounds, and the encouragement of sound fodder practices, leading eventually to the numerical limitation of cattle, can be developed and encouraged by a relatively small staff of officers with a practical farming knowledge and some gift for this form of publicity work. This has already been taken up in the Punjab and has cost Government little more than the pay of the officers so employed.... In many parts of India, indeed, the high cost of loans and the impossibility of getting any immediate economic return from reclaiming very poor and badly eroded land are seriously impeding soil conservation work. 'Self-help' projects on a community basis in the villages appear to be the most hopeful solution for farm lands....Constructive work, however, can only be done on a self-help basis of free labour, because Government cannot afford to undertake it."

The question of suitable legal action is also touched upon: "Control in the less accessible areas is difficult owing to the

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* *Erosion and Soil Conservation.* By G. V. Jacks and R. O. Whyte. Bulletin No. 25 of Herbage Publication Series, Imperial Bureau of Pastures and Forage Crops, Aberystwyth, 1938, Pp. 206. Price 5 shillings. (Also published as Technical Communication No. 36, Imperial Bureau of Soil Science, Harpenden.)

Government's aversion to interfere with hill tribes occupying the main catchment areas. Some catchments are in native States, under a varying intensity of political control ....In view of the damage done to some estates by silt deposition from others, it is felt that a strong case could be made for the legal enforcement of erosion control in the interest of the whole community....The desirability of some form of legal control, particularly in catchment areas which are of vital importance to the whole community, is illustrated by the conditions in the Uhl valley (Kangra District, Punjab), the 150 square mile catchment of a large hydro-electric project."

This very cheap but well-produced book is an essential for all those connected with any form of land use, be it live-stock, farm crops, or plantations, and should be in the hands of all who pride themselves on taking a broad interest in their country's welfare.

R. MACLAGAN GORRIE.

ASTRONOMICAL NOTES.

Planets during August 1938.—Venus will continue to be conspicuously visible in the western sky in the early part of the night. On August 28, the planet will be very close to the Moon and on August 31 it will approach the bright star Spica (α Viriginis mag. 1·2) to an angular distance of only half a degree. Mercury also can be seen as an evening star for a part of the month, before it reaches inferior conjunction with the sun on August 28. Mars rises only a little before the sun and will still be too close to it to be easily visible.

The two major planets Jupiter and Saturn will be in favourable positions for observation during the month. The former will be in opposition to the Sun on August 21 and is practically visible throughout the night. Saturn, after passing one of the stationary points of its orbit on August 1, will move in a retrograde direction in the constellation Pisces. The ring ellipse can be seen considerably widened, the major and minor axes being 43″ and 8″ respectively. Uranus is visible in the early hours of the morning near the meridian; it is situated in the constellation Aries about three degrees to the south-west of the fourth magnitude star δ Arietis. The occultation of ψ Virginis (magnitude 4·9) by the Moon on August 28 will be visible in India; the age of the Moon being only 4 days at the time, the phenomenon can be observed even without optical aid.

Gale's Comet.—The ephemeris computed for the comet indicated that the object would be getting brighter after its discovery on May 1; but contrary to expectation, subsequent observations show that the comet has become distinctly fainter, on May 9 the estimated brightness was of mag. 11 and by May 31 it had declined to mag. 13. Its period is found to be 11 years and 4 days.

A Star Cluster in Sculptoris.—In *Harvard Bulletin*, No. 908, Dr. H. Shapley gives a description of a peculiar star cluster that was photographed at the Boyden station of the Harvard Observatory. The cluster is about half a degree in diameter, of the globular type without central condensation, and is situated about 2° south of σ Sculptoris, a fifth magnitude star. From a detailed study of counts of stars in the region as well as other available data, the object appears to be a supercluster of somewhat remarkable characteristics. The dimensions are comparable to those of the galaxy and the cluster probably represents a stellar system of a new type in intergalactic space.

T. P. B.

The Austrian "Anschluss" and Science in India.

THE recent change in sovereignty in Austria has necessitated the immediate emigration of a substantial number of prominent scientists, which include two Nobel Laureates, Professors Hess and Lœwi. These migrations afford an opportunity for other countries, endowed with vision and foresight, to extend their hospitality to these men and enrich the country's scientific talent by "transfusion of new blood". England, with its high traditions for intellectual freedom, has always been the first to take advantage of such situations and we know that the best of the Jewish scientists who had to leave Germany 5 years ago were quickly absorbed by Britain. America too has been equally generous and farsighted; but India at that time lost a great opportunity. Now that a similar situation has arisen, it is suggested that India should take advantage of it.

M. S.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(*University Librarian, Madras*)

Dulong, Pierre-Louis (1785–1838.)

PIERRE-LOUIS DULONG, a celebrated French scientist, was born at Roven, February 12, 1785. Having had his early education at the Polytechnic School, he applied himself to the study of medicine. At the close of his educational career, he practised for some time as a surgeon in one of the poorest quarters of Paris. As he not only treated the poor free of charge, but also bought medicine for them, he found his vocation too expensive. Attracted by the brilliant researches of Sir Humphrey Davy, Dulong decided to devote himself to Chemistry. He was fortunate to get appointed as a pupil-assistant in Berthollot's Laboratory.

Contributions to Chemistry

His progress was such that in a few years he made a variety of important discoveries. While working with the chloride of nitrogen (discovered by him), his first knowledge of its nature was obtained from a frightful explosion, which destroyed almost all his apparatus and deprived him of the use of an eye and two fingers. This unfortunate accident did not however abate his ardour for research. In 1815 he demonstrated the true nature of nitrous acid and later he extended the number of acids formed by phosphorus from two to four.

Contributions to Physics

Dulong is perhaps best known for his contributions to Physics,—particularly for the important generalisation on the heat capacity of an element, which has immortalised his name with that of his co-worker, Petit. In 1819 Dulong and Petit, following the technique of Black in measuring specific heats of the various elements, came upon the important generalisation that the product of atomic weight (in grams) and the specific heat of an element is a constant (nearly 6). Dulong had also done some work relating to Newton's Law of Cooling and the comparison of different kinds of thermometers. His memoir (1818) on the law of cooling received the approbation of the Academy of Sciences. He also took an important part in the researches made by order of government on the elastic force of steam at high temperatures and verified the law of Mariotte up to twenty-seven atmospheres.

The Handicaps of His Times

During Dulong's time, France was a great centre for experimental research. And yet, in the words of Welch, France was long in supplying her scientific men with adequate laboratory facilities. Barnard, that prince of experimenters, worked in a damp, small cellar, one of those wretched Parisian substitutes for a laboratory which he has called " the tomb of scientific investigators ". But in spite of this, French scientists investigated and taught with enthusiasm. Dulong himself expended nearly all his wealth on apparatus.

Dulong published twenty-three papers including eight joint ones. He died at Paris, July 19, 1838.

Zeppelin, Ferdinand (1838–1917)

COUNT ZEPPELIN, German airship investigator, was born at Constance in Baden, July 8, 1838. He received a commission in the army in 1858. While on duty as observer in 1863 during the American Civil War, he made his first ascent in a balloon. From that time, the idea of aerial navigation was continuous with him. He retired from the army in 1891 and devoted himself entirely to the realisation of his one idea.

Rigid Airship

In 1889 Count Zeppelin had submitted a memo to the King of Wurtenburg containing the details of an airship. Governmental support did not however materialise. In 1898 Count Zeppelin organised a joint-stock company called the Actiengesellschaft Zur Forderung der Motor-luft-schiffahrt, which had for its objects " to experiment with, construct and navigate lighter-than-air craft ". The company started with a paid-up capital of the value of about ten lakhs of rupees.

The First Zeppelin

The first Zeppelin was sent on its first trial July 2, 1900, and attained a speed of 8½ miles. It contained 24 longitudinal aluminium girders and 16 transverse frames.

It carried 16 gas cells with a total capacity of 338,410 cubic feet. Two 16-horsepower gasoline motors were used to drive the craft. The success of this airship resulted in a marked change in the public and official attitude.

Later Progress

LZ-2 which was 414 ft. was set afloat November 30, 1905. LZ-3 was completed in 1907. The King of Wurtenburg now co-operated handsomely with him. LZ-4 had motors of 110-horsepower and attained a speed of 29 miles. During the summer of 1909, Count Zeppelin thought of the possibility of an expedition to the North Pole, but he did not pursue this idea.

Zeppelin Passenger Service

In 1910 Count Zeppelin founded the Delag (Deutsche Luftschiffert Actiengesellschaft) as the first regularly organised commercial aerial transport company. The maiden flight was made June 22, 1910 in LZ-7, christened "Deutchland" and was piloted by the Count himself throughout its route of 300 miles. The ship was elaborately fitted with cabin and restaurant facilities. During the first three years, the Delag Company carried 34,228 passengers. The number of flights was 1,587 and the number of hours of flight was 3,167. Up to 1913 Count Zeppelin had built a total of twenty-six airships, one half of which had been destroyed by one accident or another, yet amazingly without one fatality.

War Period

The outbreak of the World War in 1914 brought about a most intensive construction of Zeppelins in Germany and elsewhere. Although they were much abused, they were invaluable as scouts for the navy.

Count Zeppelin lived to see some ninety Zeppelins constructed and put to service. He died at Charletonburg, March 18, 1917.

Allen, Joel Asaph (1838–1921)

J. A. ALLEN, an American ornithologist, was born in his father's farm not far from Springfield, Mass., July 19, 1838. Only during the winter session could he be spared from farm work to attend the nearest school, a mile distant. At the age of fourteen he made his first collection of birds, which he described, attempted to draw and colour and even named totally in ignorance of the existence of published works. A little later a new world opened to him in the discovery of the volumes of Wilson, Nuttall and others, which led to his ambition, at the age of twenty, to write a history of the "Birds of New England". In 1861, he reluctantly sold his natural history collection in order to find money to go to Harvard University to study under the famous professor, Louis Agassiz. In 1865, he gained his first experience of field-work by accompanying his professor in his expedition to Brazil.

His Career

He was soon elected as curator of birds in the Harvard Museum of Comparative Zoology. While in this post (1867–85) he showed unprecedented capacity as a collector. With health impaired by long exposure in collecting expeditions, he devoted his time wholly to writing from 1876 to 1882. The result was *The American bisons, living and extinct* and *History of North American pinnipeds.* In 1885, he was appointed head of the department of birds and mammals of the American Museum of Natural History. This post he held till a few months before his death.

His Contributions

During this period, several of the most talented naturalists of America came to work under him. Under his editorship, 37 volumes of the *Bulletin* and 22 volumes of the *Memoirs* of the Museum were issued. The number of his own papers reached 198 before 1900 and a few more were published in the present century. His first paper is dated 1864. It appeared in V. 4 of the *Communications* read before the Essex Institute, Salem. It was entitled *Catalogue of the birds found at Springfield, Mass., with notes on their migrations, habits, etc., together with a list of those birds found in the State not yet observed at Springfield.*

His Honours

Honours from American and foreign Societies came thick and fast. Humbard Scholarship from Harvard, the degree of Ph.D. from the University of Indiana, the Walker Grand Prize from the Boston Society of Natural History and the Linnean Society Medal from London were the chief among them.

His enthusiasm for research led him constantly to over-tax his physical resources; yet in spite of a frail body he was actively engaged in writing and research till within a few weeks of his death.

Allen died August 29, 1921.

RESEARCH ITEMS

Tobacco Leaf Curl in Northern India.—Owing to leaf curl disease, a serious menace to the growing of Cigarette tobacco in Northern India, the leaves become puckered and thickened with prominent veins and are rendered unfit for flue-curing in barns. While in normal years only about 5 per cent. of the plants are affected, entire fields are devastated during epidemic years. Paul and Tandon (*Ind. J. Sci.*, 1937, 7) have studied the incidence and epidemiology of the disease. They found that the time of sowing has an influence on the incidence of the disease, the early June planting being more affected than the late August planting, probably due to the activity of the insect vector during the monsoon months. Five types of leaf curl have been differentiated. Inoculation of healthy plants with juice from diseased plants always failed to produce infection, but the disease was transmitted by graft infection.

Most of the experiments were carried out by the authors with the variety *Pusa H. 142*, which was found to be less severely attacked than the American types, *viz.*, *Harrison special* and *Casle.* The removal of diseased plants early and replacement with healthy ones is recommended by the authors who have recorded nineteen per cent. less disease in treated plots than in the untreated ones. The possibility of controlling leaf curl by spraying the nursery against the attack of the insect vector and by breeding resistant varieties is indicated. M. J. N.

The Artificial Colouring and Ripening of Fruits with Ethylene.—*The Monthly Bulletin of Agricultural Science and Practice* of the Institute of Agriculture for the month of March 1938, is a number of particular interest to the fruit industry, as it contains a comprehensive account of the use of ethylene gas in the artificial colouring, ripening and storage of fruits and vegetables. The history of this interesting process, the production and properties of ethylene, its iufluence on the biochemical process of maturation and on the different fruits and vegetables, the actual technique of using the gas, the various factors affecting the process such as the concentration of the gas, the temperature, moisture and ventilation in the storage chambers, the time of storage, etc., together with a description of the methods as applied to the different fruits like bananas, citrus fruits, dates, apples, pears, melons, tomatoes and so on, are dealt with in all their essential aspects. An exhaustive list of references is also appended. It is interesting to recall that this method is only an extension of nature's own process, for the discovery that ethylene is produced when fruits are stored and that it accelerates the ripening of the backward ones has been the starting point of all the later investigations that have led to its commercial application.

The results of much experimental work show that independently of the factors temperature and relative humidity, the action of ethylene varies considerably according to the variety of the fruit and for the same variety according to the stage of its ripeness; its action is however definite and unquestionable in changing the green colour into yellow by the decomposition of the chlorophyll into colourless substances, a decomposition which enables the yellow pigments of the skin (carotins and xantophylls) to show up; the ethylene has no effect on these pigments. In the majority of fruits the ethylene accelerates to a more or less considerable degree the digestion of the starch and the formation of compound sugars; the inversion of sucrose into invert sugar, the removal of tannins; the digestion of the constituents of the cell walls—in fact the sum total of the ripening changes. The action on the acidity is however an exception, as the change is not always uniform. Of much interest to India especially, is the finding that in regard to mangoes, oranges, papayas and bananas, the use of ethylene opens to these fruits a very extensive market, as it is possible to dispose of them in distant markets in perfect condition. Mangoes acquire a ripe colour in 3 or 4 days, and the quality of the fruit does not suffer. Citrus fruits colour to perfection in 2½ to 5 days and the method is specially valuable in the case of oranges which are excellent in quality but are patchy or poor in colour. This we may remark, incidentally, is a special drawback of some of the important orange tracts at all seasons and of most orange groves in certain seasons. It is true that some primitive indigenous methods for colouring fruit are known and practised in our country but the use of these scientific methods under conditions capable of perfect control and the certainty of a uniform result open out a promising prospect for the fruit trade, as it will enable it to cater to distant and profitable markets. A. K. Y.

Temperature and Locust Activity.—Mr. M. Hussein's work, carried out in London and pubished in Cairo, on the effect of temperature on the activities of three species of locusts, *viz.*, the African Migratory Locust, *Locusta migratoria migratorioides*, R. & F., the Desert Locust, *Schistocerca gregaria*, Forsk., and the Red Locust, *Nomadacris septemfasciata* Serv., constitutes the first comprehensive work on the subject under carefully controlled laboratory conditions (*Bull. Ministry of Agriculture, Egypt*, No. 184; Govt. Press, Bulâq, Cairo, 1937). Various stages of locusts were kept in chambers which were either gradually cooled or heated, and their behaviour noted. The author recognises eleven stages in their behaviour, ranging from Cold Stupor (stage 0) to Normal Activity (stage 5). Excitement (stage 7) and finally Heat Stupor (stage 10) beyond which (51·7–55·6° C.) death supervenes after very short exposures of 5–15 minutes. It is further recognised that three main factors govern the reaction of the individuals to temperature. These are: (i) Size of body and duration of exposure to the different temperatures; (ii) Length of period intervening from previous moult; and (iii) state of sexual development of adults. Mr. Hussein's contribution is not only of considerable theoretical interest but also of practical import in locust control work since the broadcasting of poison-baits is best done shortly before the commencement of feeding which, in its turn, is largely governed by the temperature of the environment.

M. L. Roonwal.

Optical Quartz.

ONE of the largest and finest quartz crystals ever to enter the United States went into the vaults of the Bausch & Lomb Optical Co. recently. Coming from the Province of Minas Geraes in Brazil, where it was brought by mule pack from the diamond section of the Serra da Mantiqueira range, 1,500 miles from the coast, the huge crystal weighs sixty-three pounds and costs $18·00 per pound. Based on optical quality, experts believe that it surpasses any museum piece of this type in the country.

Although quartz, a form of silica occurring in hexagonal crystals, is distributed throughout the world, no deposits of suitable optical quality have been found in the United States. Brazil is the chief source of supply and Bausch & Lomb is the chief purchaser.

The crystal is solid matter in its most perfectly developed and naturally organized condition. Its exterior is characterised by a form of extraordinarily regular geometrical design. The internal structure is, likewise, so regular that the arrangement of the structural units, or chemical molecules, is precisely the same about one point as every other point.

" If the growth of the crystal has been slow, undisturbed, and unrestricted in all directions," says Fred C. Breuck, who has studied optical minerals for 25 years, "its external shape is that of a closed solid, the surface of which is entirely made up of numerous plane facets, or faces, meeting in straight edges, brilliantly smooth, as if highly polished. The arrangement of these facets, measured by their mutual inclinations, is characteristic of each crystal." "Frequently", says Brueck, " the facets are not only truly plane, but as highly polished as though done by a jeweller's lapidary."

Light is reflected and refracted through the crystal. Viewed in sunlight or bright artificial light, the scintillation of spectrum-coloured rays shows the beautiful properties of transparent crystal.

Quartz is a uniaxial crystal—one with two different directions of refractive index—and the interference colors may be brought about by the phase difference in various wavelengths of light. The crystal may absorb part of the components of white light, producing a definite color which not only gives color to the mineral, but also modifies the tone of interference colors by removing from white light the components absorbed by the crystal.

Since the phase difference between extraordinary and ordinary rays emerging from a uniaxial crystal depends on the length of path traversed—thickness of the quartz plate—and on the relative velocities of the two rays, and the relative velocities depend upon the character of the crystal and the direction in which the plate is cut from it, the interference color is related to the thickness of the plate. If the plate is not uniformly thick, it will show interference colors in different places.

" Crystals are frequently found," says Brueck, " which are obviously of a composite character, or composed of more than a single crystal of the same substance, in which there are two, or even three, parts belonging to separate crystals, although they are united in a definite and regular manner. Their twin nature is often betrayed by the presence of what are known as ' re-entrant angles,' forming notches, arrowhead shapes, knee shapes and cruciform, or heart shapes. Frequently two or more individual crystals are so intimately blended that the appearance at first sight is that of a single individual crystal, a crystal of a higher degree of symmetry than a single crystal."

Brazilian crystals are characterised by a peculiar kind of interpenetration, "twinning," Brueck explains as he examines a slab of quartz under his polarizing microscope. " There are two different crystals in this one block. One piece has a right-handed movement like a clock, while the other has a left-handed movement, counter-clockwise. The interpenetration here is but partial and the twin has the appearance of a mirror-imge, or reflection twin."

It is Brueck's job to determine the optical axis of the crystal before it is cut, to detect flaws, and to extract the greatest proportion of usable crystal from the material. To do this, he uses plane polarised light, vibrating in a straight line, or circularly polarised light which vibrates in a circle, because the character of the crystal is more easily detected than in ordinary light. Quartz crystals exhibit, among other things, one set of concentric coloured circles, with a dark maltese cross extending across the field.

Quartz crystals are used by Bausch & Lomb for lenses and prisms because of their high transparency and the superior resolution obtained with this material in the shorter wavelengths of light, such as the ultra-violet. The shorter the wavelength of light the greater the resolving power, disclosing more details in the structure under observation.

Although the microscope is now equipped with special ultra-violet accessories, it is in spectrographs, spectrometers, and monochromators that the chief necessity for quartz optics exists.

Biologists, cytologists and histologists benefit by the use of quartz accessories for the microscope because of the ability to differentiate better between various cell and tissue structures, while the spectroscopist utilises quartz instruments in detecting various elements whose identifying lines lie in the ultra-violet portion of the spectrum.

SCIENCE NOTES.

The Goggle-eyed Fish or Mud-Skipper.—At the Ordinary Monthly Meeting of the Royal Asiatic Society of Bengal held at Calcutta, on Monday the 4th July, Dr. Baini Prashad exhibited the habitat group of the goggle-eyed fish or mud-skipper *Periophthalmodon schlosseri* (Pallas).

"Gobies of the general *Periophthalmodon* and *Periophthalmus* represent in their habits, two of the most terrestrial types among fishes. They frequent the sea-shores and estuarine mud-flats of the Indo-Pacific Region, and are sometimes found considerably above the water-level, on aerial roots of plants and other objects that may be present in their habitat.

"The mud-skippers breathe atmospheric air direct, and their skin is especially modified for conserving moisture. Their eyes are well adapted for a sharp aerial vision, and they use their highly muscular pectoral fins for locomotion on land. They feed on small animals that are left stranded on the mud-flats by the receding tides.

"The exhibit shows a portion of the foreshore of Matlah at Port Canning. The dwarf Sundari shrubs (*Avicennia officinalis* L.) with their aerial roots form a characteristic feature of the habitat. The other noteworthy inhabitants of the mud-flats or of the associated saline pools are the Crabs, *Varuna litterata* (Fabricius) and *Gelasimus annulipes* Laterille and molluscs of the family Cerithidæ".

* * *

The Statistical Year-Book for the Year Fasli 1344 (1935 A.D.) of H.E.H. the Nizam's Government, Hyderabad.—(By Mazhar Husain, Director of Statistics.-1937, pp. 800. Price Rs. 5.)-H.E.H. the Nizam's Government deserve to be congratulated on the publication of this *Year-Book* which brings together in one compendious volume the statistics which heretofore were being published as parts of the reports of the different departments of Governments. The convenience of such a handy volume is obvious and we should heartily commend this idea for adoption by other Governments in India. The *Year-Book* comprises both abstract and detailed statistics of the area and population, revenue and expenditure under land revenue, forests, customs, excise, mines, mints, post offices, public works and railways, administrative statistical informations relating to the military, police, education, vital statistics, medical and other departments, agricultural statistics including meteorology, crop forecasts and live-stock and statistics of trade and industry including Banking and Co-operative Societies. Statistics are given for four years ending 1935, a feature which enables one to obtain an idea of the progress made from year to year. Special efforts are stated to have been made to make the statistics complete but in spite of such efforts the statistics are said to be incomplete. This and the fact that the present latest statistics themselves are quite three years old somewhat detract from the value of the publication. A useful feature of the agricultural statistics, we are glad to note, is the districtwar total yield of the different crops which are given side by side with the acreages. The book is a mine of statistical information relating to the Hyderabad State brought together in a single volume.

A. K. Y.

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Solar Observatory, Kodaikanal.—Considerable increase in all forms of solar activity is recorded in the *Report* for 1937 of the Government of India Solar Observatory at Kodikanal.

Compared with 1936 the mean daily numbers of sunspots showed an increase of 41 per cent. The number of new groups observed was 34 per cent. more than in 1936. There were no days on which the sun was found to be free from these spots.

Weather conditions were slightly more favourable for solar observations than during the previous year.

A further study of high dispersion spectrograms of the chromosphere and prominences without an eclipse has revealed the presence of oxygen in prominences.

Photometric work on the intensities and contours of selected Fraunhofer lines in the red has been continued with the grating spectrograph. Work on a systematic study of the line contours in different points of the sun's disc has been begun using a 13-foot prism spectrograph and monochromator constructed for the purpose.

The Observatory has continued to extend its co-operation in working out the programme of the International Astronomical Union and has been keeping in touch with the work of solar observatories abroad.

The measurements of the photographs of the total eclipse of the sun on 19th June, 1936, taken by the previous Director who was deputed by the Government of India to Japan for observing the eclipse, have been completed and the results have been published.

The *Report* contains a number of interesting details of a technical nature.

* * *

The Indian Association for the Cultivation of Science.—The *Annual Report* of the Association for the year 1937, just issued, shows that during the year a number of investigations bearing on the magnetic studies on organic crystals, graphite and paramagnetic crystals, X-ray analysis of crystal structure, magnetic properties of mixed Tutton salts and the directional properties in the fluorescence of aromatic molecules, were carried out under the auspices of the Association by Prof. K. S. Krishnan, Mahendralal Sircar Professor of Physics, and his associates.

43 Papers were published in the *Indian Journal of Physics and Proceedings of the Indian Association for the Cultivation of Science*, during the year.

The Government of India renewed their annual grant of Rs. 18,000 for the year 1937–38, and have generously restored the 10 per cent. cut for the year 1938–39. During the year, Sir James H. Jeans, D.SC., F.R.S., Dr. F. W. Aston, D.SC., F.R.S., Sir Arthur Hill, D.SC., F.R.S., Sir Lewis L. Fermor, D.SC., F.R.S., and Prof. J. E. Lennard Jones, D.SC., F.R.S., addressed the Association. Mr. Santilal Banerjee, M.SC., a research scholar of this Association, has been awarded the

Dr. Sircar Research Medal and also the Jatindra Chandra Prize. The Nikunja Garabini Prize has been awarded to Mr. Asutosh Mookerjee, M.Sc., a research worker of the Association.

* * *

The **Industrial and News Edition** of *the Journal of the Indian Chemical Society*, Vol. I. Nos. 1 and 2 published under the joint auspices of the **Indian Chemical Society** and the **Institution of Chemists** (India), has just reached our hands. The number before us covers 82 pages and contains original contributions bearing on lac, textiles, coal and food industries. The finding that the kernel fats and oils from the seeds of the *Lauracea* family contain 70–96 per cent. of lauric acid, has rendered possible the use of these oils as raw materials in the manufacture of sodium lauryl sulphate, which finds extensive application as a detergent. A valuable contribution bearing on this subject has been contributed by Dr. S. V. Puntambekar. From the results of the chemical examination of 8 samples of Indian coal, Roy, De and Guha suggest that the coals from the series classified as Desherghur group, Poniati group, Kajore-Jambad group and Saltore seam are fairly suitable for low temperature carbonisation, as the yields of tar obtained per ton of coal, are considerable. The other contributions include "Bleaching of Lac," by N. N. Murthy, "Mineral Elements in Nutrition," by U. P. Basu, "Estimation of Dye Absorption of Indian Cottons" by Nazir Ahmad and D. L. Sen, "Indian Coal for the Manufacture of White Portland Cement" by M. R. Mandlekar, "Oxycellulose and Hydrocellulose" by R. B. Forster, S. M. Kaji and K. Venkataraman and a "Note on the Products from Citrus Fruits" by J. L. Sarin. Other features of the *Journal* include, Technical and Research Notes, Notes and News, Reviews and Indian Patent Literature. The get-up of the *Journal* is good, and if the present standard is maintained, its future is assured.

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A review of the development and progress in the plastics industry with brief descriptions of natural and synthetic binders, moulding equipment and the production and uses of plastics has recently been published. ("Plastics," by S. Ranganathan and H. K. Sen, Reprinted for the *Proceedings of the Institution of Chemists, India*). There are a number of plates illustrating the machinery and finished articles.

A perusal of this pamphlet will help even a layman to get an idea of the present-day plastics.

* * *

The Morgan Rotary Retort.—The report of the test by the Director of Fuel Research, on the Morgan Rotary Retort installed at Rodridge Hall, near Wingate (County Durham), has just been issued (H. M. Stationery Office, London, pp. iv + 22, price 10 *sh.* net, post free). "The Department of Scientific and Industrial Research has been empowered by the Government to test low-temperature carbonisation plants at the Public expense, subject to certain conditions. The object of these tests is to place in the hands of those interested, accurate technical data on the quality and quantity of the yields, the throughput of the plant, the working temperatures, etc., and the general ease of working. No attempt is made to pronounce on the commercial possibilities of the plant. for these can only be judged after working a plant under a steady load for a long period and in the light of complete knowledge of local conditions of prices, markets and labour costs.

The present report, the sixteenth of the series, describes a test carried out by the Staff from the Fuel Research Station on the Morgan Rotary Retort installed at Rodridge Hall, near Wingate, Co. Durham. The plant is of intermediate size, dealing with a throughput of about 4–6 tons of coal per day. Although not intended for commercial operation, it is considered to be large enough to yield data capable of being interpreted directly in terms of a commercial-scale unit dealing with about 30 tons per day. The process consists in carbonising the coal by mixing it in a rotating retort with a charge of red-hot coke.

Following a detailed account of the design and operation of the plant, the report describes the arrangements made for measuring and sampling the raw materials and products, and for conducting the test. Each product was subjected to a detailed examination, the results of which are given, and the report concludes with some general observations on the operation of the plant and of the difficulties encountered."

* * *

The Mount Everest Expedition.—The fifth attempt to reach the Everest was abandoned owing to heavy snow on the Himalayas. The Expedition reached a height of 27,200 feet, *via* the west side of Rongbuk.

Full details of the progress of the Expedition are available from the despatches of Mr. Tilman, the leader of the Expedition, to the "*Hindu*" (July 4th). The party left Gongtok on March 4, reached Rongbuk on April 6 and occupied the base camp on April 10. After reaching Camp III on April 25, some members of the party explored the North Col Slopes. The party had to descend to Kharta (11,000 ft.) and spend a few days there as the members were suffering from coughs, colds and sore throats. Camp III was again reached on May 18, and Camp IV on May 24. Camp V was established on 6th June and on the next day the expeditionists reached the next camp (27,200 ft.). Attempts to proceed higher were frustrated due to thigh-deep powder snow on the edges. A second futile attempt was made to climb the heights on the 11th. The Expedition had, however, the distinction of reaching 27,300 feet under monsoon conditions, a record, of which the veteran mountaineers can be proud.

The suggestion that a small party of mountaineers should make an attempt every year in May has been made by Mr. Tilman, and the hope expressed, that a favourable season will occur, sooner or later, which will enable the conquest of the Everest.

* * *

Vitamin Nomenclature.—At the Fifth Annual Meeting of the American Institute of Nutrition, held in Baltimore on March 30, 1938, the Committee on Vitamin Nomenclature reported :—

" The term **Vitamin F** has been used in various ways in the past but recently has come into

widespread use in promoting the sale of linseed oil and products alleged to contain the so-called 'essential fatty acids'. A group of biochemists interested in fat metabolism gave consideration to this matter during our last meeting. They forwarded to this Committee their recommendation that the term 'Vitamin F' should not be used in referring to linoleic or linolenic acids, or the so-called 'essential fatty acids'. Your committee is in accord with these views. It is recommended that the term **'Vitamin F'** should not be used in referring to linoleic or linolenic acids or any fatty acids or mixtures of fatty acids".

The term **Riboflavin** was formally adopted for the compound identified as 6, 7 dimethyl-9 (d-ribityl) *iso*alloxazine in place of the term Vitamin B_2 or Vitamin G. The term Riboflavin was approved at the last session but final adoption was withheld until the opinion of other groups had been ascertained. No definite objections having been received for this proposal, the term Riboflavin was formally adopted.

Vitamin E.—In a communication appearing in *Nature* (June 11, 1938, p. 1057) P. Karrer and Co-workers have reported the synthesis of α-Tocopherol (Vitamin E). The reaction of phytyl bromide with trimethyl-hydroquinone gives the racemic form of α-tocopherol, which can be resolved into its optically active forms by means of brom-camphor sulphonic acid. Biological tests with this synthetic product gave excellent vitamin E activity.

* * *

Professor B. S. Madhava Rao, D.Sc.—We congratulate Prof. B. S. Madhava Rao on the recent academic distinction of the D.Sc. degree being conferred upon him by the Calcutta University. Prof. Madhava Rao's contributions in the field of Pure and Applied Mathematics are well known and most of them have received the warmest acclamation of European and American scientists. The University of Mysore, to which Prof. Madhava Rao and Dr. Ramaswamy belong, must be gratified that two of their young professors have received academic recognition of their researches.

Dr. K. L. Ramaswamy, D.Sc.—The degree of Doctor of Science, has been conferred on Mr. K. L. Ramaswamy, M.Sc., by the Madras University, in consideration of his thesis entitled "Studies in the Electrical and Optical Polarisabilities of Gases and Vapours". Dr. Ramaswamy is a student of Prof. H. E. Watson, and several papers on dielectric constants of gases either by himself or in collaboration with Prof. Watson, have appeared in the *Proceedings of the Royal Society*. We have pleasure in offering our felicitations to him on the distinction conferred on him.

Dr. L. S. Ramaswamy, D.Sc.—We have pleasure in offering our felicitations to Dr. L. S. Ramaswamy, Department of Zoology, University of Mysore, on his receiving the D.Sc. degree of the Madras University. Dr. Ramaswamy is well-known as a keen and industrious research worker and his numerous papers published both in India and abroad have won for him the warm appreciation of those competent to judge his work. The award of the D.Sc. degree was made "Contributions to Our Knowledge o Osteology of Anura". We hope th swamy, who is still young and ener ther extend his researches and rec honours.

* * *

Dr. R. S. Krishnan, D.Sc., a res attached to the Raman Physics I the Indian Institute of Science, has the 1851 Exhibition Scholarship fo of further investigations in Englan Krishnan's published works have alre great attention, and recently he D.Sc. degree of the Madras Univer the second time that the Exhibitio comes to the Physics Laboratory c Institute of Science. Mr. N. S. Na was the first recipient of the Sch outstanding work received wide-sprea very early and his researches in th of Cambridge have earned for him t of being one of the foremost Theoreti from India. While congratulating we express the hope that he, in con Mr. Nagendra Nath will, by thei justify the demand of India for mor being awarded to deserving your The award of the Scholarship on occasions to the same department unique feature in the history of the tute of Science.

The Science Scholarships Comm Royal Commission for the Exhibit has, on the recommendation of the Madras, awarded a similar Sch **Dr. N. K. Panikkar, M.A., D.Sc.**, a ed graduate of the Madras Universit in Zoology at the Marine Biologica at Plymouth.

* * *

Benares Hindu University.—Ac *United Press* message, H. H. the Balarampur has donated Rs. 75,000 versity.

* * *

University of Travancore.—Dip in Textile Technology and Textile C certificate courses in (*a*) weaving, (dyeing, printing and finishing, (*c*) needlework and knitting and (*d*) ca coir-weaving, have been started fr mencement of the current academi Diploma course in Textile Technolog Chemistry extends over 3 years.

* * *

Announcements.

Prize for Improvements in Implements or Machines.—In courage inventors to improve existin of cultivation and to design new im machines better suited to Punjab co within the power of the average purchase, the Punjab Government to institute a scheme of prizes. during the scheme, applications wi for a suitable design of a particu agricultural implement or machine.

ll be open to all *irrespective of nationality.* overnment servants can compete subject to the rrent of the Government under whom they are nployed.

During the current year a prize of Rs. 3,000 offered for a suitable design for a bullock drawn ltivator. The implement must be simple in sign, cheap in cost, so as to be within the pur asing power of an average cultivator; capable repairs by an average village blacksmith; icient in stirring up fallow land quickly after in or irrigation, in order to conserve the maxi um amount of moisture in the soil, and suitable r the inter cultivation of crops sown in lines.

The cost of manufacturing the cultivator must ot exceed Rs. 15.

Competitors must submit applications setting rth the advantages claimed for their respective signs and accompanied by scale drawings and ecifications, which must be sufficiently com ete in all details to enable a manufacturer to ake the implement.

The applications will be examined by an Expert ommittee, which will select for manufacture for ial purposes designs which hold promise of fficient merit. Applicants whose designs are so lected will be required to deliver the implement complete working order at Lyallpur or else here in the Punjab within one month of receipt instructions. Actual pocket expenses up to maximum of Rs. 50 will be allowed. The ward of the Committee will be final.

The entry, for which the prize is awarded, will come the sole property of the Punjab Govern ent, which also reserves the right to postpone or ithhold the award of the prize if no entry of fficient merit is received.

Applications, complete in all respects, must ach the Director of Agriculture, Punjab, Lahore, y *31st October* 1938, *at the latest.*

The Third International Congress for the tudy of Goitre will be held on September 13 14 Washington, when the following subjects will discussed: (1) endemic goitre, cretinism and yxoedema; (2) thyroid gland and metabolism, utrition and endocrine glands; (3) hyperthyroid m. Further information can be obtained from r. Allen Graham, 2020 East 92nd Street, leveland, Ohio, U.S.A.

The Sixteenth International Congress of Physiology will be held at Zurich on August 4 18 under the presidency of Prof. W. R. Hess. t will consist of six sections devoted respectively general and comparative physiology, bio hysics, biochemistry, applied physiology (work, port and aviation), psychophysiology and pharma ology. Further information can be obtained om Prof. K. Rotlin, Sonnenweg 6, Basel, witzerland.

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The attention of our readers is invited to the llowing advertisements appearing in this issue f *Current Science*:

1. Director, Indian Institute of Science, Bangalore. Salary: not exceeding Rs. 2,000 per mensem. Last date for application: 15th September 1938.

2. Professor of Chemical Technology, the University of Bombay. Salary: Rs. 800 50 1,000. Last date for application: 15th August 1938.

* * *

We acknowledge with thanks, receipt of the following:

"Forschungen und Fortschritte," Vol. 14, Nos. 17 18.

"Journal of the Mining and Geological Institute of India," Vol. 31, No. 1.

"League of Nations; Bulletin of Health Organisation," Vol. 7, No. 1.

"Bulletin of the American Meteorological Society," Vol. 19, Nos. 2, 3 and 4.

"Review of Applied Mycology," Vol. 17, No. 5.

"American Museum of Natural History," Vol. 41, No. 5; Vol. 42, No. 1.

"Nature," Vol. 141, Nos. 3573 81.

"Journal of Nutrition," Vol. 15, Nos. 5 and 6.

"Research and Progress," Vol. 4, No. 3.

"Canadian Journal of Research," Vol. 16, Nos. 4 and 5, A, B, C and D, and Index to Vols. 1 12.

"Journal of Research" (National Bureau of Standards), Vol. 20, No. 1, and Index to Vol. 18.

"Sky," Vol. 2, Nos. 7 and 8.

"The Indian Trade Journal," Vol. 129, Nos. 1668 72.

"Bulletin of the Patna Science College Philosophical Society," No. 8.

"Agricultural Gazette of New South Wales," Vol. 49, No. 6.

"Journal of Agricultural Research," Vol. 56, Nos. 5 7.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 29, No. 5.

"Agriculture and Live-stock in India," Vol. 8, No. 3.

"The Philippine Agriculturist," Vol. 27, No. 1.

"Journal of the Royal Society of Arts," Vol. 86, Nos. 1462 65.

"Journal of the Indian Botanical Society," Vol. 17, Nos. 2 3.

"Chemical Age," Vol. 38, Nos. 987 990.

"Journal of Chemical Physics," Vol. 6, No. 6.

"Journal of the Indian Chemical Society," Vol. 15, No. 4.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 71, Nos. 5 6.

"Journal de Chemie Physique," Vol. 35, Nos. 3 4.

"Experiment Station Record," Vol. 78, No. 5.

"Transactions of the Faraday Society," Vol. 34, No. 206.

"Indian Forester," Vol. 64, No. 7.

"University of Illinois Bulletin," Vol. 35, Nos. 52 and 55.

"Medico Surgical Suggestions," Vol. 7, Nos. 4, 5 and 6.

"Calcutta Medical Journal," Vol. 33, No. 6; and Vol. 34, No. 1.

"Indian Journal of Venereal Diseases," Vol. 4, No. 2.

"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 8, Pt. II.

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Vitamin E.—In a communication appearing in *Nature* (June 11, 1938, p. 1057) P. Karrer and Co-workers have reported the synthesis of α-Tocopherol (Vitamin E). The reaction of phytyl bromide with trimethyl-hydroquinone gives the racemic form of α-tocopherol, which can be resolved into its optically active forms by means of brom-camphor sulphonic acid. Biological tests with this synthetic product gave excellent vitamin E activity.

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Professor B. S. Madhava Rao, D.Sc.—We congratulate Prof. B. S. Madhava Rao on the recent academic distinction of the D.Sc. degree being conferred upon him by the Calcutta University. Prof. Madhava Rao's contributions in the field of Pure and Applied Mathematics are well known and most of them have received the warmest acclamation of European and American scientists. The University of Mysore, to which Prof. Madhava Rao and Dr. Ramaswamy belong, must be gratified that two of their young professors have received academic recognition of their researches.

Dr. K. L. Ramaswamy, D.Sc.—The degree of Doctor of Science, has been conferred on Mr. K. L. Ramaswamy, M.Sc., by the Madras University, in consideration of his thesis entitled "Studies in the Electrical and Optical Polarisabilities of Gases and Vapours". Dr. Ramaswamy is a student of Prof. H. E. Watson, and several papers on dielectric constants of gases either by himself or in collaboration with Prof. Watson, have appeared in the *Proceedings of the Royal Society*. We have pleasure in offering our felicitations to him on the distinction conferred on him.

Dr. L.S. Ramaswamy, D.Sc.—We have pleasure in offering our felicitations to Dr. L. S. Ramaswamy, Department of Zoology, University of Mysore, on his receiving the D.Sc. degree of the Madras University. Dr. Ramaswamy is well-known as a keen and industrious research worker and his numerous papers published both in India and abroad have won for him the warm appreciation of those competent to judge his work. The award of the D.Sc. degree was made on his thesis "Contributions to Our Knowledge of the Craneal Osteology of Anura". We hope that Dr. Ramaswamy, who is still young and energetic, will further extend his researches and receive brighter honours.

* * *

Dr. R. S. Krishnan, D.Sc., a research student attached to the Raman Physics Laboratory of the Indian Institute of Science, has been awarded the 1851 Exhibition Scholarship for prosecution of further investigations in England. Dr. R. S. Krishnan's published works have already attracted great attention, and recently he received the D.Sc. degree of the Madras University. This is the second time that the Exhibition Scholarship comes to the Physics Laboratory of the Indian Institute of Science. Mr. N. S. Nagendra Nath was the first recipient of the Scholarship. His outstanding work received wide-spread recognition very early and his researches in the University of Cambridge have earned for him the reputation of being one of the foremost Theoretical Physicists from India. While congratulating Dr. Krishnan, we express the hope that he, in conjunction with Mr. Nagendra Nath will, by their researches, justify the demand of India for more scholarships being awarded to deserving young scientists. The award of the Scholarship on two distinct occasions to the same department is certainly a unique feature in the history of the Indian Institute of Science.

The Science Scholarships Committee of the Royal Commission for the Exhibition of 1851, has, on the recommendation of the University of Madras, awarded a similar Scholarship to **Dr. N. K. Panikkar, M.A., D.Sc.**, a distinguished graduate of the Madras University for research in Zoology at the Marine Biological Laboratory at Plymouth.

* * *

Benares Hindu University.—According to a *United Press* message. H. H. the Maharaja of Balarampur has donated Rs. 75,000 to the University.

* * *

University of Travancore.—Diploma courses in Textile Technology and Textile Chemistry and certificate courses in (*a*) weaving, (*b*) bleaching, dyeing, printing and finishing, (*c*) embroidery, needlework and knitting and (*d*) carpet-making, coir-weaving, have been started from the commencement of the current academic year. The Diploma course in Textile Technology and Textile Chemistry extends over 3 years.

* * *

Announcements.

Prize for Improvements in Agricultural Implements or Machines.—In order to encourage inventors to improve existing implements of cultivation and to design new implements and machines better suited to Punjab conditions and within the power of the average cultivator to purchase, the Punjab Government have decided to institute a scheme of prizes. Each year during the scheme, applications will be invited for a suitable design of a particular improved agricultural implement or machine. These prizes

will be open to all *irrespective of nationality.* Government servants can compete subject to the consent of the Government under whom they are employed.

During the current year a prize of Rs. 3,000 is offered for a suitable design for a bullock-drawn cultivator. The implement must be simple in design, cheap in cost, so as to be within the purchasing power of an average cultivator; capable of repairs by an average village blacksmith; efficient in stirring up fallow land quickly after rain or irrigation, in order to conserve the maximum amount of moisture in the soil, and suitable for the inter-cultivation of crops sown in lines.

The cost of manufacturing the cultivator must not exceed Rs. 15.

Competitors must submit applications setting forth the advantages claimed for their respective designs and accompanied by scale drawings and specifications, which must be sufficiently complete in all details to enable a manufacturer to make the implement.

The applications will be examined by an Expert Committee, which will select for manufacture for trial purposes designs which hold promise of sufficient merit. Applicants whose designs are so selected will be required to deliver the implement in complete working order at Lyallpur or elsewhere in the Punjab within one month of receipt of instructions. Actual pocket expenses up to a maximum of Rs. 50 will be allowed. The award of the Committee will be final.

The entry, for which the prize is awarded, will become the sole property of the Punjab Government, which also reserves the right to postpone or withhold the award of the prize if no entry of sufficient merit is received.

Applications, complete in all respects, must reach the Director of Agriculture, Punjab, Lahore, by 31*st October* 1938, *at the latest.*

The Third International Congress for the Study of Goitre will be held on September 13–14 at Washington, when the following subjects will be discussed: (1) endemic goitre, cretinism and myxœdema; (2) thyroid gland and metabolism, nutrition and endocrine glands; (3) hyperthyroidism. Further information can be obtained from Dr. Allen Graham, 2020 East 92nd Street, Cleveland. Ohio, U.S.A.

The Sixteenth International Congress of Physiology will be held at Zurich on August 14–18 under the presidency of Prof. W. R. Hess. It will consist of six sections devoted respectively to general and comparative physiology, biophysics, bio-chemistry, applied physiology (work, sport and aviation), psychophysiology and pharmacology. Further information can be obtained from Prof. E. Rottlin, Sonnenweg 6, Basel, Switzerland.

* * *

The attention of our readers is invited to the following advertisements appearing in this issue of *Current Science*:—

1. Director, Indian Institute of Science, Bangalore. Salary: not exceeding Rs. 2,000 per mensem. Last date for application: 15th September 1938.

2. Professor of Chemical Technology, the University of Bombay. Salary: Rs. 800–50–1,000. Last date for application: 15th August 1938.

* * *

We acknowledge with thanks, receipt of the following:—

"Forschungen und Fortschritte," Vol. 14, Nos. 17–18.

"Journal of the Mining and Geological Institute of India," Vol. 34, No. 1.

"League of Nations; Bulletin of Health Organisation," Vol. 7, No. 1.

"Bulletin of the American Meteorological Society," Vol. 19, Nos. 2, 3 and 4.

"Review of Applied Mycology," Vol. 17, No. 5.

"American Museum of Natural History," Vol. 41, No. 5; Vol. 42, No. 1.

"Nature," Vol. 141, Nos. 3573–81.

"Journal of Nutrition," Vol. 15, Nos. 5 and 6.

"Research and Progress," Vol. 4, No. 3.

"Canadian Journal of Research," Vol. 16, Nos. 4 and 5, A, B, C and D, and Index to Vols. 1–12.

"Journal of Research" (National Bureau of Standards), Vol. 20, No. 1, and Index to Vol. 18.

"Sky," Vol. 2, Nos. 7 and 8.

"The Indian Trade Journal," Vol. 129, Nos. 1668–72.

"Bulletin of the Patna Science College Philosophical Society," No. 8.

"Agricultural Gazette of New South Wales," Vol. 49, No. 6.

"Journal of Agricultural Research," Vol. 56, Nos. 5–7.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 29, No. 5.

"Agriculture and Live-stock in India," Vol. 8, No. 3.

"The Philippine Agriculturist," Vol. 27, No. 1.

"Journal of the Royal Society of Arts," Vol. 86, Nos. 4462–65.

"Journal of the Indian Botanical Society," Vol. 17, Nos. 2–3.

"Chemical Age," Vol. 38, Nos. 987–990.

"Journal of Chemical Physics," Vol. 6, No. 6.

"Journal of the Indian Chemical Society," Vol. 15, No. 4.

"Berichte der Deutschen, Chemischen Gesselschaft," Vol. 71, Nos. 5–6.

"Journal de Chemie Physique," Vol. 35, Nos. 3–4.

"Experiment Station Record," Vol. 78, No. 5.

"Transactions of the Faraday Society," Vol. 34, No. 206.

"Indian Forester," Vol. 64, No. 7.

"University of Illinois Bulletin," Vol. 35, Nos. 52 and 55.

"Medico-Surgical Suggestions," Vol. 7, Nos. 4, 5 and 6.

"Calcutta Medical Journal," Vol. 33, No. 6; and Vol. 34, No. 1.

"Indian Journal of Venereal Diseases," Vol. 4, No. 2.

"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 8, Pt. II.

ACADEMIES AND SOCIETIES.

Indian Academy of Sciences:

June 1938. SECTION A.—K. C. PANDYA AND T. S. SODHI: *The Condensation of Aldehydes with Amides—Part I. The Condensation of Salicylaldehyde.*—It is found that the catalytic influence of a base promotes the reaction better and gives a purer product. R. K. MEHRA AND K. C. PANDYA: *Condensation of Malonanilic Acid with Aromatic Aldehydes.*—Using only a trace of pyridine or piperidine gives a better yield. R. K. MEHRA AND K. C. PANDYA: *The Condensation of Aldehydes with Amides.—Part II. The Condensation of Cinnamaldehyde.*—The presence of the base does not very much affect the yield. The product in all cases is the Cinnamalidenbisamide. K. C. PANDYA AND T. S. SODHI. *The Condensation of Aldehydes with Malonic Acid in the Presence of Organic Bases. Part X. The Condensation of 2 : 4-Resorcylaldehyde.*—Umbelliferon or Umbellic Acid is obtained according to conditions. A trace of pyridine gives a better yield. D. K. JAIN AND R. R. AGARWAL: *On the Amylase from the Indian Water Chestnut* (Trapa bispinosa *Roxb.*)—*Part II. Studies with the Purified Powdered Form of the Enzyme.*—The course of the action of the enzyme on starch has been studied. H. GUPTA: *A Generalisation of Leudesdorf's Theorem.* T. S. SURATKAR, S. M. MEHTA AND MATA PRASAD: *A Study of the Systems* $CuSO_4$-$NiSO_4$-H_2O-*and* $CuSO_4$-$CoSO_4$-H_2O. K. S. K. IYENGAR: *On Linear Transformations of Bounded Sequences.—I.* L. S. HEBLE AND T. S. WHEELER: *Kinetics of the Reaction between Benzyl Chloride and Formic Acid.*—The velocity of the reaction decreases with increase in concentration of benzyl chloride in formic acid and is much slower than that calculated from the observed heat of activation.

June 1938. SECTION B.—HUSAIN KHATIB: *Four Cases of Abnormalities in the Blood Vascular System of the Common Indian Frog* (Rana tigrina *Daud.*).—For the first time abnormalities in the anterior venous and the arterial system have been recorded in the common Indian frog. Three explanations for the abnormal post-caval vein have been put forward on ontogenetic grounds. G. N. RANGASWAMI AYYANGAR, V. PANDURANGA RAO AND B. W. X. PONNAIYA: *Studies in Sorghum: The Non-Auriculate and E-Ligulate Condition.*—With the suppression of the auricle and ligule there is an absence of the pulvinus and a shortening of the spikelet-free area in the panicle branches and branchlets. This leads to a choking overcrowding of the spikelets on the earhead and consequent risk of sterility. In highly evolved sorghums with auricle and ligule the presence of the pulvinus and pushing away of the grain-bearing area from the central axis have resulted in producing an economic earhead. M. C. CHERIAN AND MOHAMED BASHEER: Brachymeria excarinata, *Gahan (Family Chalcididæ) a Pupal Parasite of* Plutella maculipennis, *Curtis, in South India.*—An account of the pupal parasite of the Diamond-back moth. G. W. CHIPLONKER: *Rhynchonellids from the Bagh Beds.*—A critical examination of the Rhynchonellids from the neighbourhood of Chirakhan (Indore State) with a view to studying their phylogeny. B. THIRUMALACHAR: *On Certain Double Monstrosities of Gambusia.*—A brief description of the occurrence of double monstrosities in viviparous fish. M. ABDUSSALAM: *On a New Nematode Parasite of the Himalayan Flying Squirrel* (Pteromys inornatus *Geoffroy*).

Indian Association for the Cultivation of Science: (*Proceedings, Vol. XXI, Part II*).

April 1938.—K. BANERJEE AND A. HAQUE: *Structure of Aromatic Compounds, Part III.—Benzophenone.* U. K. BOSE: *Cathodic Sputtering.* M. RAZIUDDIN SIDDIQI: *On the Theory of a Non-linear Partial Differential Equation of the Elliptic Parabolic Type.* S. N. BOSE: *On the Total Reflection of Electromagnetic Waves in the Ionosphere.* S. C. SIRKAR AND J. GUPTA: *On the Heat Capacities of a Few Crystals at Low Temperatures.*

Indian Chemical Society:

April 1938.—SHRIDHAR SARVOTTAM JOSHI, DUSHYANT NARASINGASA SOLANKI AND T. V. SUBBA RAO: *Influence of Non-electrolytes on the Cathode Efficiency of Copper Deposition.* SHRIDHAR SARVOTTAM JOSHI AND S. PADMANABHAN: *Studies of Some Physico-Chemical Factors in the Electrodeposition of Silver.* M. N. RUDRA: *Studies in Vitmain C, Part V.—The Vitamin C Content of Some Germinated Cereals and Pulses.* K. ASWATH NARAIN RAO AND P. R. VENKATA RAMAN: *Isomeric Triazocinnamic Acids and Related Compounds.* S. K. MITRA: *Thioketonic Esters, Part VII.—Thio-thiol Estimation.* NRIPENDRA NATH CHATTERJEE: *A New Synthetic Route to Polycylcic Hydroaromatic Compounds. Synthesis of 2 : 3 Benz-bicyclo (0 : 3 : 3)-octene.* KUNJ BEHARI LAL AND H. KRALL: *The Phenylthiocarbamides—A Contribution to the Study of the Triad N C S—Part VI. Action of Nitrous Acid on a Methylphenylthiocarbamide.* KUNJ BEHARI LAL AND H. KRALL: *The Phenylthiocarbamide—A Contribution to the Study of the Triad N C S. Part VII—A Reinvestigation of the Extent of Some Hydrolytic Decompositions of Phenylthiocarbamide. Reactions of sodium ethoxide on phenylthiocarbamide and of acetic anhydride and Hydrolytic Agents on αα- and α-Methylphenylthiocarbamides.* G. P. PENDSE: *Dyes Derived from Thiohydantoin—Part III.*

Erratum.

Vol. VI, No. 12, June 1938, contribution entitled "Production and Measurement of Low Temperatures", page 591, equation (3)

for "$\left(\frac{\partial u}{\partial v}\right)_T = T\left(\frac{p}{\partial T}\right)_v - p$" *read* "$\left(\frac{\partial u}{\partial v}\right)_T = T\left(\frac{\partial p}{\partial T}\right)_v - p$"

1047-38.—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore.

CURRENT SCIENCE

Vol. VII] August 1938 [No. 2

The Calder Plan.

THIS is essentially an age of social reconstruction and it must naturally abound in social speculations. The unprecedent progress of physical sciences and the application of the scientific discoveries and inventions to the industrial processes induced a general confidence in the public mind that the line of human development was definitely set in the direction of reason. The faith of the old generation that the betterment of man depended upon his technical advance was frustrated because society as a whole was not organised to receive the benefits of their mechanical progress. Hopes are entertained that, if the social problems are handled in a scientific way, the disharmonies of the world may be assuaged, and a better order of social affairs may be established. For over a decade Sir Richard Gregory and others have been emphasising on the recognition of a change of scientific interest from the physical and biological to the sociological, and as a result of this campaign, the British Association for the Advancement of Science in 1932 was led by Professor Miles Walker to pass a resolution offering its services in the solution of the economic and social problems. This eminently friendly attitude of science towards social environment has now become an article of public faith among scientists, who realise the importance of the relationship between science and society, considered historically in all its continually changing aspects.

The American Association for the Advancement of Science, at its recent session held in Indianapolis, passed a resolution based on the principles of what is called "The Calder Plan". This Plan insists upon a "declaration of the independence of Science"—a *Magna Charta* of Science. The principal features of this Plan are set forth by Richie Calder himself in an illuminating article published in a recent issue of the *Science Forum.*[1] The fundamental idea underlying this Plan is that Science should enjoy absolute freedom in the organisation of research and in the exchange of ideas,—"a free trade in brains," being the badge of the scientific tribe. The implication of scientific discoveries and inventions is that they should

[1] *The Science Forum,* June 1938, **3**, 7–11.

be harnessed for the common good of mankind, and for the purpose of prosecuting scientific researches, scientific workers should be left untrammelled to pursue their studies in an atmosphere of peace. It is a portentous fallacy that scientific knowledge could be treated as an exclusive national asset, its blessings are universal. These facts must form the general creed of scientists who ought to own allegiance to no other doctrine.

The British Association for the Advancement of Science which has been keenly alive to the consequences of the impact of Science on a greatly exasperated world, has been considering for a long time the necessity of shifting its alignment to meet the demands of the changing conditions in the social and economic systems. At the Blackpool session and at subsequent meetings the Association recognised the need of bringing into existence an organisation for enquiring in an objective spirit the social relations of science. In view of the common ideals animating the spirit and outlook of the two Associations, Calder proposes in the first instance the formation of "an English-speaking Consortium" which should ultimately develop into a democratic World Association, devoted to the consideration and solution of "international social problems, with the safeguarding of the interests and independence of scientists". The membership of this somewhat fat Association is to be thrown open to all scientists subscribing to the *Magna Charta* of the scientific democracy, who, accepting the responsibility of their position, should act as a link between the specialist in their own particular branch of knowledge, and those who are responsible for government, so that the world of scientific discoveries might do the greatest good to mankind. It is doubtful, however, whether the scientists in the totalitarian states will recognise, the democratic principles of science, and whether the proposed organisation will include the Nazi and Fascist scientific men.

On account of the rather unwieldy dimensions of this Association which naturally would be unable to attend to the routine day-to-day work, Calder has devised an auxiliary organisation which would receive knowledge, initiate enquiries and researches and which would co-operate with the other social and political institutions of the world. This auxiliary body is to act as the "brain-trust" for the World Association and on the analogy of the technical committees of the League of Nations, this subsidiary trustee "would be adviser of all nations, but as an association, subject to none". Calder's idea of a "Science League of Nations" which is only another name of his World Association has been summarised by the *New York Times* in these words: "Mr. Calder has not exaggerated. To save science, his World Association is needed, an organisation which shall indicate how the objective attitude of the laboratory may be applied in governing a people, in breaking down prejudices, in preventing war, in solving problems that mean progress, not in one country alone, but the world over." The labours of Calder are devoted to "bring to a tortured world, perplexed and frustrated by the ineffectiveness, by the animosities, prejudices and chauvinism of the world's statesmen, the objectivity, the disinterested enquiries and the laboratory thoroughness of science and you may give the world peace and rationalism; help to dispense as well as to provide the bounty of science, and achieve economic security and the fullness and fruitfulness of the Age of Plenty for the peoples of all nations".

These sentiments are admirable and the proposed World Association is heroic. Both are great ideals which, we fear, are still laid up in Heaven.

The British Association has proposed a less ambitious scheme, based on the series of articles in *Nature* on the "rapidly growing awakenness of the importance of these complex problems confronting our community, due primarily to the astonishing rate of advance of scientific knowledge during the last generation" and with the object of obtaining representative opinions upon the subject of social repercussions of science, a symposium was recently organised. In the supplement to *Nature*[2] is published a series of letters contributed by about forty leading scientists and publicists whose comments emphasise the necessity of going deeper into the social relations of science and indicate in general outline the principal activities to be undertaken and the methods of achieving the underlying objects. It is obvious that as the sciences become specialised, they tend to develop a spirit of

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[2] *Nature*, April 23, 1938, **141**, 3573, 723–42.

exclusiveness and pretentious airs are disastrous to sciences as they must be to society, whose problems are created by science. With a view, therefore, to bring about a closer relationship between scientific and social workers, the British Association is proposing to establish a new organisation, a Society for the Study of the Social Relations of Science. At the forthcoming meeting of the British Association at Cambridge, the proposal for the formation of a society of this nature is expected to be discussed, and we envisage that a definte scheme will be put forward for organising the scientific workers into a comprehensive body who would devise a mechanism for the application of scientific knowledge in promoting social well-being and betterment. Time is not far off for India to establish international affinities with these movements which, we hope, will point the way for a better and a happier world state.

The Fisheries of India.

By J. Travis Jenkins, D.Sc., Ph.D.,

Superintendent, Lancashire and Western Sea Fisheries Joint Committee, Preston, England.

(*Formerly Fishery Adviser, Government of Bengal.*)

IT is now thirty years since the late Sir K. G. Gupta submitted to the Government of Bengal his report on the fisheries of the province. In this report he asked for a systematic survey of each district under expert supervision and on definite lines " and the results are sure to be valuable and far-reaching ".

Sir K. G. Gupta's report may be read with advantage even to-day, since he draws attention to many problems affecting the fisheries of the province which still require investigation and elucidation. In 1915 the first Madras Fishery Bulletin was published by Sir F. A. Nicholson. It dealt with papers from 1899 relating chiefly to the development of the Madras Fisheries Bureau. In 1937 Dr. Sundara Raj published the administration report for the year 1935–36. Between those two dates the Madras Fisheries Bureau has published a long list of papers and reports dealing with the fisheries of that province.

In 1910 Mr. Kiran Chandra De published at Shillong, a valuable and interesting report on the fisheries of Eastern Bengal and Assam, and there are other provincial reports which it is not essential to specify more exactly.

Now while these various reports are very interesting and some are extremely valuable, there is one obvious defect and that is the lack of co-ordination due to the fact that the fisheries are controlled by the Provincial and not the Central Government.

On the first of July, 1916, the Zoological Survey of India was inaugurated so that it came of age last July, when its twenty-first birthday was attained. Apart from maintaining the zoological collections of the Indian Empire in the Indian Museum at Calcutta, one of the chief tasks of the Survey was to obtain the fullest possible information about the systematic and geographical zoology of the Indian Empire and to place this information at the disposal of inquirers.

Outside scientific circles it is not widely known that the Secretary of State for India in Council publishes volumes dealing with the Fauna of British India including Ceylon and Burma. If we look up the volumes dealing with fish we find that they were published as long ago as 1889, the author being the late Francis Day; who also published reports on the Fresh-water Fish and Fisheries of India and Burma (1873), and the Sea Fisheries.

It is interesting to note that a second edition of the volumes on Fish in the Fauna of India is in the course of preparation by Rai Bahadur Dr. Sunder Lal Hora. This edition, which will have to be entirely rewritten to be effective, will extend to at least five volumes. It will be seen, therefore, that there are several independent bodies interested in the Fish and Fisheries of India, namely the Zoological Survey of India, the Provincial Governments and the Secretary of State. Now, although much information has already been obtained as a reference to the above-mentioned reports will show, it is obvious that very much more remains to be done and that there is urgent need for further investigations and particularly for co-ordination.

How can this best be secured ?

Nearly every civilised country in Europe, America and Africa with important fishery interests has a central fishery bureau or department either directly working as a

government department or directly controlled by such a branch.

India with its vast rivers, estuaries, tanks and ponds on the one hand, and its enormous coast line and marine fish on the other hand, with enormous potentialities for development, simply cannot afford to drop behind. The development of markets for fresh fish, with the allied problems of transport and ice, the preservation of fish whether by canning, smoking or other process, the investigation of the fish-oils and other bye-products such as fish-meal and manure, all offer problems requiring urgent investigation and offering results of immediate practical value.

This problem was considered in the year 1938 at a combined meeting of the Indian Science Congress Association and the British Association for the Advancement of Science held in Calcutta, when the sections of Zoology, Medical Research, Veterinary Research, Entomology and Agriculture held a joint session. Following this the Zoology Section passed the following resolution :—

" This meeting of the Zoology Section of the *Indian Science Congress Association* in session at Calcutta, urges upon the Government of India the necessity and importance of constituting an all India Department of Fisheries for the development of the fishery resources of Indian waters on scientific lines. It is of opinion that the commercial development of the fisheries of India should be accompanied by the scientific investigation of fishery problems by means of a carefully planned programme of co-ordinated scientific investigation of fishery problems, which can most easily be controlled by one central authority for All-India, leaving to the separate Provincial Governments the task of administration of the fishery laws and regulations.

It is further of opinion, that, unless development of the fishery resources of Indian waters is carried out with due regard to the scientific principles which form the basis of successful fishery developments, there will be grave danger of irreparable damage to the fisheries concerned."

As an example of what can be done to assist the fisheries by a properly constituted central bureau subsidised by the Government, let us take Japan.

Japan now produces annually half-a-million cases of canned crabs, worth over two million pounds sterling. In 1937 Great Britian imported 39,220 cwts. of canned " crabs " from Japan worth £333,773. This so-called crab is not a crab at all but a species known as *Paralithodes camtschatica* and is not to be compared in quality or flavour with the prawns of the Bay of Bengal and the Gangetic Delta.

Great technical difficulties were met with in the first attempts to can these crabs and it is in a very large degree due to government subsidized research that this great Japanese fishing industry has been built up in comparatively few years.

Last year Great Britain imported canned Norwegian sprats to the value of £ 263,309.

In the Bay of Bengal there are enormous shoals of fish resembling the sardine and far superior in flavour to the sprat. The Kokile (*Clupea kunzei*) of the Telugu fishermen is a case in kind. In some countries there is an enormous demand for salted mackerel. Here again the Bay of Bengal can supply the demand. The Kanagurta (*Scomber microlepidotus*) is an excellently-flavoured fish.

The home market for fish is quite inadequately developed. There is scope for much research into the best methods of conveying fish, either fresh or lightly cured, to the home markets.

Many people have an idea that Indian waters are devoid of fish of good flavour and high nutritious value. There can be no greater mistake. There are Indian fish which compare favourably with the best in the world. There are no better fish anywhere than the Hilsa, Bhekti, Topsi and the " Bombay Duck ". The crabs, shrimps and prawns are unsurpassed. There can be no doubt whatever that the material is there. What is wanted is proper investigation so that these immense resources may become available for the benefit of the community. There is only one way, in India as in other lands, and that is, the scientific investigation of fish and fish products on the lines so successfully established in the United States of America, Japan and most European countries.

This was fully recognised by the experts who attended the Science Congress in Calcutta last January. Prof. Tattersall, Lt.-Col. Sewell, Prof. de Beaufort and others supported the resolution outlined above.

It is to be hoped that the Government of India will establish a Central Bureau of Fisheries at an early date so that the immense wealth of Indian waters at present lying dormant and undeveloped may be developed rationally. India is fortunate today in having available men like Dr. Hora, Dr. Prashad and Dr. Sundara Raj with considerable experience in fish and fishery matters who could assist in the formation and development of any organisation formed to develop the fisheries of the country.

The Control of the Blight Disease of Gram by Resistant Types.

By Jai Chand Luthra, I.A.S., R.S., Abdus Sattar, Ph.D., and
Kishan Singh Bedi, M.Sc. (Ag.).
(*Punjab Agricultural College and Research Institute, Lyallpur.*)

In the Punjab, gram or chick-pea (*Cicer arietinum*) occupies the largest area next to wheat. Including Indian States it has an acreage of about 5½ millions. Its greatest value lies in the fact that it is almost the only Rabi crop that can be successfully grown in the Vast Barani (rain-fed) tracts of the province and therefore carries great economic importance for the bulk of the farming population of these areas.

For decades of years this valuable crop has been suffering severely from the attack of the blight disease caused by the fungus *Ascochyta rabiei* (Pass) Lab. Often it has broken out in epidemic form particularly in the northern districts of Attock, Rawalpindi and Jhelum bringing about total destruction of the crop. For the last two successive years, the gram crop has been altogether wiped out. Every plant was killed at the flowering and fruiting stage and not a single grain was recovered from diseased fields. The investigation of this serious disease was entrusted to the authors in 1932 and the work so far done on the study of the life-history of the causal fungus and measures of its control have been published.[1, 2]

Symptoms.—The most marked symptoms of the disease are :—

Dark brown spots appear on stem, leaflets and pods. These spots form elongated lesions on stem and petiole. But on leaflets and pods they are circular and concentrically arranged. Minute black dots are produced on the lesions. These are the spore bodies (Pycnidia). The parts of the plant above the lesions collapse and dry up. Terminal portions are invariably first affected. The disease usually appears in February and if there are showers of rain accompanied by wind, it spreads very rapidly by dissemination of spores and continues up to April. Within a fortnight the disease has been observed to overtake many fields and kill the crop.

The disease has been found to be carried over from one season to the other by—

(1) infected seed ;

(2) by diseased debris left in fields after the crop is harvested.

The methods of control recommended are : (1) use of clean disease-free seed, (2) clearing of the fields of all diseased material. But unless these methods are adopted collectively all over the gram growing areas and executed to perfection, the disease cannot be checked. The process of cleaning of fields and threshing floors has to be accomplished with such thoroughness that not the least of infected material escapes collection and destruction. Both the methods have to go together. In practice, however, the farmers have not shown much anxiety and initiative to employ the methods to the desired extent. Under such circumstances, the alternative course has been to discover types resistant to the disease.

For this purpose, 187 types of gram obtained from America and Europe and several parts of India, were grown and tested by artificial inoculation with cultures of the causal fungus and diseased material as follows :—

(1) By spraying pycnospores in suspension in water. The spores were taken from pure culture of the fungus *Ascochyta rabiei* grown in oat-meal agar for three weeks. The plants were kept covered by *Sarkanda* for about a week to provide moist conditions for the development of the disease. The inoculations were done in February each year and in order to provide a heavy dose of infection the inoculations were repeated in March again.

(2) By spreading diseased gram plant debris over the plants after having first ascertained that the stalks of the debris were bearing a large number of pycnidia of *Ascochyta rabiei* and more than 70 per cent. of the spore contained in them were viable. The plants inoculated by this method were not covered with *Sarkanda*. Both the methods gave equally good results.

All the Indian types and most of the foreign types caught infection and were killed. Only three types among others supplied by the Bureau of Plant Industry, Washington, U.S.A., were observed to withstand inoculation and proved resistant fully or partially. These are the following :—

(1) *Pois chiches* No. 281 – Very resistant.
(2) *Pois chiches* No. 199 – Very resistant.
(3) *Pois chiches* No. 180 – Fairly resistant.
(4) *Pois chiches* No. 4F32 – Very resistant.

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[1] Luthra, J. C., and Bedi, K. S., *Ind. J. Agric. Sci.*, October 1932, **2**, Part V.

[2] Luthra, J. C., Sattar, A., and Bedi, K. S., *Agr. and Live-Stock in India*, September 1925, **5**, Part V.

These types appear to have been imported into Washington from France.

These types gave distinct indications of resistance from the first year of trial in 1933 and single plant selections were made. The isolation of vigorous plants and those well-adapted to the climate was continued every year.

About 2 oz. seed of each type was all that was got to begin with. Inoculation tests and pedigree culture of selected plants have been carried on for the last five years. The three foreign varieties 4F32, 199 and 281 remained outstanding regarding power of resistance. Slight infection occurred under severe inoculation tests, but no damage was caused. Some lesions were formed but no pycnidia developed. It appears that infection was not followed by penetration of the fungus and the tissues were not injured. Though these types cannot be classed as immune, yet their power of resistance is strong enough to protect the crop from the disease. Type 281 is most resistant, 4F32 comes next and 199 is third in this respect. The seeds of these types have distinctive morphological characters. Type 281 has black colour, slightly rough surface, large size and irregular shape. Weight of the seed is $2\frac{1}{4}$ times the usual type.

Type 199 has dull white colour, smooth surface and medium size. Seed is about $1\frac{1}{2}$ times in weight of the grain of a normal type. It resembles the well-known Punjab small Kabuli type.

4F32 has yellow colour, rough surface like Punjab type 7, but has prominently larger size and is about $1\frac{1}{2}$ times in weight. This type being similar to a local gram and having very little of foreign features, is readily acceptable to the farmers. Of the three types, this was selected as most suitable for introduction into the husbandry of the Province as a new production to replace the local seed and combat the blight disease. It was, therefore, decided to focus attention on it and test it for yield. In 1936 sufficient seed became available for this purpose. It was sown in eight replications of 1/32 acre each. As the seed of 4F32 weighs 1·5 times that of Punjab type 7, the standard seed rate of 16 seers was increased to 24 seers in order to get a comparable stand and normal number of plants per acre. Good and uniform germination was obtained and the average yield was 14 maunds 13 seers per acre. This out-turn compares very favourably with the general yield got from local types. Similar yield trials were carried out in 1937–38 season and out-turn of the order of 14–16 maunds per acre was obtained. The type has proved satisfactory as regards yield and thus fulfils one of the crucial tests usually applied to determine the value of a newly evolved strain from the view-point of the farmer, *i.e.*, adequate return per acre. Besides, the most significant and priceless asset of the type is its ability to withstand the destructive blight disease on account of the prevalence of which the cultivation of gram in the north Punjab has become problematical. The poor farmer of this tract is threatened with loss of the only means of existence. Gram is the life and soul of the people and blight has been a calamitous visitant and a great menace for long to this part of the country. The evolution of the resistant strain is a precious boon to them and the surrounding area including the North West Frontier Province where also the disease has made a deep foothold. Sixty maunds of seed of this valuable type 4F32 has been raised this year. For convenience of reference it has been given the new name of type F.8. A comparison of resistant type 8 and Punjab type 7 after severe inoculation is shown in Fig. 1. Pb. type is almost completely killed while type F.8 is flourishing.

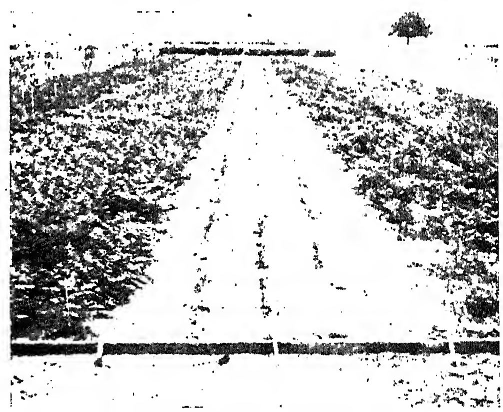

FIG. 1.—Plots of gram (*Cicer arietinum*) type F. 8 and type Punjab 7 after inoculation with the blight fungus *Ascochyta rabiei* (Pass) Lab.

Arrangements will be made next season to further multiply this seed by growing it on Government farms under strict supervision. One hundred acres will be sown with it in October 1938. It is expected that in 1940 about 25,000 maunds of seed of this type will be in hand for supply to farmers and a considerable part of the blight-stricken area will be relieved of the virulent pest.

This newly evolved type is evidently a great contribution to disease-resistant

strains of farm crops evolved in India and is a sure means of overcoming the ravages of the serious blight disease of gram. Experience has convinced the authors that in the matter of control of diseases of staple crops grown on extensive areas, neither spraying nor clean-up methods, however effective they may be, are of any avail in India as it is impossible to get farmers to carry them out to perfection. Ultimately the solution lies in the direction of finding out resistant types as is being done in Australia, America and other countries to control Flag Smut, Bunt, Wilt, etc.

OBITUARY.

Dr. Alfred Barton Rendle, D.Sc., F.R.S., F.L.S. (1865–1938).

DR. ALFRED BARTON RENDLE, D.Sc., F.R.S., F.L.S., who died at his home at Leatherhead, Surrey, on January 11th at the age of 72, was for many years Keeper of the Department of Botany at the British Museum of Natural History.

He was born in London on January 19th, 1865 and educated at St. Olave's Grammar School, Southwark, and St. John's College, Cambridge.

In 1888 he was appointed Assistant in the Botanical Department of the British Museum. In the same year he was elected a member of the Linnean Society of London. In 1894 he became Lecturer in Botany at the Birkbeck College where he taught for two or three evenings in the week until 1906. In 1906 he was appointed Keeper of the Department of Botany and his work and interests increased and broadened. He became connected with the Royal Horticultural Society, the Quekett Microscopical Club, the British Association for the Advancement of Science, and after the International Botanical Congress in Vienna in 1905 he took an active part in deliberations concerned with revision of rules for Botanical Nomenclature. In 1909 he was elected a Fellow of the Royal Society and later served as President of the Linnean Society. From 1929–1931 he served on the Council of the Royal Society. He became Professor of Botany to the Royal Horticultural Society and served on several of their scientific and administrative committees. This Society bestowed medals on him in 1917 and 1929 in recognition of his achievements and services.

Dr. Rendle wrote numerous papers on botanical subjects and a text-book,—the *Classification of Flowering Plants*. He was botanical editor of the eleventh edition of the *Encyclopædia Britannica* and from 1924 he edited the *Journal of Botany*. He prepared new editions of the *Bibliographical Index of British and Irish Botanists* and Bentham's *British Flora*. He also collaborated with William Fawcett (died 1926) in preparing a *Flora of Jamaica* on the sixth volume of which he was still working. He was keenly interested in the protection and preservation of the wild flowers of the British Isles and presided at meetings of Societies of Naturalists in different parts of England. He continued to be occupied with much of this work after his retirement from the post of Keeper in 1930.

He took part in many meetings of the British Association for the Advancement of Science, and in 1916 was President of the Botanical Section. With this Society he visited Australia, Canada and South Africa. A visit to Bermuda and Jamaica in 1933 stimulated his interest in the flora of these islands. He had never visted India, apart from a day or so in Ceylon, and as a representative of the British Association he was keenly anticipating taking part in the twenty-fifth (Silver Jubilee) session of the Indian Science Congress Association this January. This venture was tragically cut short by the illness which proved fatal. He contracted a chill on the boat on his way to India. This aggravated some latent trouble and after a week in hospital in Bombay he was advised to return immediately to England. He reached his home on January 8th and died peacefully there three days later.

The writer had the opportunity of working with Dr. Rendle at the British Museum (Natural History), London, a little before he left for India when he expressed much enthusiasm for his prospective visit to India. Dr. Rendle's keen interest in the writer's works and his valuable suggestions in the researches on Systematic Botany will be of considerable use. Dr. Rendle's courteous manners, his pleasant dealings and his willing co-operation in scientific works will be remembered by all who came in touch with him. We deplore his death and offer our most sincere sympathy for the bereaved family.

K. P. BISWAS.

LETTERS TO THE EDITOR.

Magnetic Anisotropy of Egg Shells.

The author has determined the magnetic anisotropy of several specimens of egg shells by the methods described in his earlier papers on the magnetic anisotropy of natural substances.[1] Egg shell according to Stewart[2] essentially consists of: (1) a thin outer layer made of protein, (2) middle layer (comprising 80% of the thickness of the shell) of calcite crystals with protein in the form of interlacing fibres and a small quantity of crystalline calcium phosphate and (3) small knob-like formations of calcite and calcium phosphate constituting the inner "mamillary" layer. Langworthy[3] gives the percentage composition of the shells as follows:

	Organic matter	Calcite	Magnesium carbonate	Calcium phosphate
Hen's egg ..	4·2	93·7	1·3	0·8
Duck's egg ..	4·3	94·4	0·5	0·8

Only the middle layer consisting almost entirely of calcite was taken up for examination. The specimens were cleaned with very dilute HCl followed by distilled water and alcohol. The results representing the mean of several determinations carried out with four specimens of hen's egg and two of duck's are given in the table below. The specific anisotropy refers to the difference in the susceptibilities parallel and perpendicular to the shell surface in the case of egg shells, and parallel and perpendicular to the optic axis in the case of calcite. The mean susceptibilities were measured by means of the Curie torsion balance.

It is seen that while the susceptibilites of the shells are almost the same as that of calcite, the values of the magnetic anisotropy are found to be much lower. These results are significant in the light of the optical examination of egg shells under the polarising microscope.[4] It has been found that calcite is present in the form of columnar prisms in the middle layer, and examination under convergent polarised light of a tangential section of the shell has revealed that the optic axes of the prisms are inclined to the shell surface. Further, with parallel polarised light it has been found that the extinction directions for the different prisms are different, indicating a random orientation *in azimuth* of the optic axes of the prisms relative to the shell surface. The magnetic measurements fit in very well with these findings. Correlation of the magnetic anisotropy of the shells with that of calcite shows that the lower value of the anisotropy of the shells can be satisfactorily explained as being

TABLE.

Units—c.g.s. E.M.

Specimen	Specific Magnetic anisotropy $\chi_{\|}l - \chi_{\perp}r$ $\times 10^8$	Mean susceptibility $\times -10^6$	Remarks
Hen's egg ..	1·2 (1·0 – 1·4)	0·35	The anisotropy in the plane of the shells was practically negligible.
Duck's egg ..	1·6 (1·4 – 1·9)	0·36	
Calcite ..	3·45	0·38	A clear specimen of Iceland spar.

due to the inclined orientation of the optic axes of the calcite prisms and the random orientation of these axes in azimuth relative to the shell surface. The latter also accounts for the absence of anisotropy in the plane of the shells. An interesting feature of the results is that the anisotropy of hen's egg is definitely lower than that of duck's egg. This would indicate that the calcite crystals in the latter have their optic axes more nearly normal to the shell surface than in the former.

My thanks are due to Prof. Sir C. V. Raman for suggesting this line of work.

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August 8, 1938.

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[2] Stewart, *Poultry Sci.*, 1935, **14**, 24.
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Dielectric Strength of Lacs of Known Origin.

SHELLAC varnishes are extensively employed for the insulation of electrical machinery but no systematic work on the dielectric strength of such varnishes prepared from different varieties of lac has so far been carried out. Verman[1] has drawn pointed attention to this in his paper on the dielectric properties of lac. Poole[2] measured the dielectric strength of films from alcoholic solution of shellac and solid castings, and obtained discordant results. Mackay,[3] and Flemming and Steel,[4] also measured the breakdown voltages of shellac castings and films but details are lacking regarding the percentage of the lac samples and conditions under which the tests were carried out. Similarly, it is stated that hard lac resin possesses enhanced electrical properties[5] but no experimental data are available.

We have carried out experiments with a view to ascertaining the electrical properties of lac from different hosts and those of the hard lac resins prepared from them by hot extraction with dilute soda and fractional precipitation from soda solution.[6] The results will be helpful in choosing the right type of lac to be used in the manufacture of insulating varnishes and indicate the best method of preparing hard lac resin possessing increased dielectric strength and moisture resistance.

The object of the electrical breakdown tests was not so much to determine the absolute value of the dielectric strength as to get comparative data on the different specimens of varnishes. From the data so obtained, the best type of lac for further investigation has been picked out.

The dielectric strength tests were carried out under the following three different conditions.

(1) On varnish films dried at 27° C. for 48 hours in an atmosphere of about 75 per cent. humidity.

(2) On varnish films prepared as in (1) and subsequently baked for half an hour in an oven at 90° C.

(3) On varnish films prepared as in (1) but subsequently exposed for 72 hours to an atmosphere of about 95 per cent. humidity at 27° C.

The films were prepared by dipping sheets of tissue paper twice in the varnish in a manner similar to that described in Appendix I of B. S. S., No. 119–1930. The brass test electrodes were each $1\frac{1}{2}''$ in diameter with rounded edges. The weight of the top electrode was approximately 1 lb. The bottom electrode was maintained at earth potential and the voltage between them was increased at a uniform rate until the film punctured. The maximum reading of a voltmeter, connected to the tertiary winding of the testing transformer, was noted at each breakdown. The primary of the transformer was supplied from a 25 cycle source of nearly sinusoidal wave form. Each film was punctured at six different points and the average value noted. The thickness of the film was measured close to the points of puncture by a micrometer and the average taken in reckoning the voltage per mil. The average thickness of the films tested was about 3 mils. The results have been tabulated as shown below.

Note.—All the lac samples were dissolved in 95 per cent. alcohol to give solutions of sp. gr. 0·884 at 27° C.

All the tests were carried out with the electrodes at room temperature.

The results indicate that Jalari lac has a higher dielectric strength than sagade lac. Another interesting point which emerges from this investigation is that seed lac on being dissolved in soda and precipitated acquires a higher value of breakdown voltage. It is surprising that tests after drying at 27° C. give a lower value for the hard lac resins than the original lac but the values increase enormously on heating the specimens at 90° C. for ½ hour. There are three possible reasons to explain such a behaviour.

(1) The films may be freed from water and/or some other conducting liquid locked up therein.

(2) Heating may induce an alteration in the physical state of the film.

TABLE I.

No.	Material	Solid content in 100 c.c. alcoholic solution	Acid value	Breakdown voltage in volts per mil.		
				After drying at 27° C. for 48 hours	After baking at 90° C. for ½ hour	After exposure to 95% humidity for 72 hrs.
1	Sagade seed lac (*Schleichera Trijuga*)	24·36	79·0	1420	1200	600
2	Whole lac dissolved in soda, filtered and precipitated ..	27·26	85·5	1200	1640	570
3	Hard lac resin by fractional dissolution in soda	25·66	83·9	1000	1450	390
4	Hard lac resin by fractional precipitation	23·44	66·5	1190	1750	455
5	Soft lac resin from (4) ..	25·26	84·2	1100	1850	410
1	Jalari seed lac (*Shorea Talura*)—					
	Sample (1) Old	23·80	87·2	1320	1320	580
	,, (2) Fresh	23·90	81·5	1410	1840	620
*2	Whole lac dissolved in soda, filtered and precipitated ..	24·82	88·8	1450	2000	460
*3	Hard lac resin by fractional dissolution in soda	24·36	68·6	1160	1940	400
*4	Hard lac resin by fractional precipitation	23·54	58·6	1120	1910	400

* Prepared from Sample 2 of Jalari lac.

(3) Intramolecular change through polymerisation and condensation of the lac may take place.

We wish to thank Professors K. Aston and K. Sreenivasan for their keen interest and encouragement.

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2 *Phil. Mag.*, 1921, **42**, 488.
3 *Can. Chem. & Met.*, 1931, **15**, 215.
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Choline Esterase in Cobra Venom.

The venom of the Indian Cobra (*Naia Naia Vel tripudians*) is a substance of very complicated composition and possesses a remarkable pharmacological activity. A large amount of literature has collected on the subject and many investigators have attempted to explain the cause or the causes which are responsible for the peculiar toxic manifestations produced by the venom. Most of the investigations reported in the literature are centred around the question of the identification and separation of the various constituents, to each of which can be attributed a particular toxic property. Earlier workers like Calmitte[1] believed that the protein fraction (toxalbuminoids) was the active constituent in the venom but later experiments tended to show that certain principles of a non-protein nature might also be involved. Faust[2] reported the isolation of a non-nitrogenous, non-glucosidal principle from the cobra venom (ophiotoxin) which was very closely related in its physical, chemical and pharmacological characters to the saponins. This principle produced all the effects of whole snake venom, except agglutination. That the enzymes present in the venom might have some part to play in bringing about the toxic manifestations of venom poisoning was first brought out by Mathews[3] who showed that the destruction of fibrinogen by the protease present in the *crotalus* (*crotalus adamenteus*) venom was the chief cause of the failure of the blood to clot in *crotalus* poisoning. This finding was later confirmed by Billing.[4] These observations naturally drew the attention of a number of workers (Ganguly,[5] Ghosh *et al*[6]) to the study of the nature and physical and biochemical characteristics of the various enzymes or enzyme complexes present in the cobra venom. Recently, Iyengar, Sehra and Mukerji[7] investigated in detail the nature of the protease in the cobra venom and attempted to explain the biochemical significance of the presence of this enzyme with special reference to the use of the venom in therapeutics. Roy and Chopra[8] studied the comparative biochemical characteristics of the cobra and Russell's viper venom with a view to identify, if possible, the constituents of the venom primarily responsible for the poisoning symptoms associated with snake bites.

The action of the cobra venom in experimental animals was investigated by Chopra and Iswariah.[9] It was shown that the main action of this venom in lethal and sub-lethal doses is on the respiratory system, the effect being one of initial stimulation and final paralysis. The respiratory centre is probably primarily involved but the motor end-plates in the diaphragm and other respiratory muscles are also affected almost simultaneously. There is considerable divergence of opinion with regard to the exact mechanism involved in bringing about the respiratory paralysis. Chopra and Iswariah (*loc. cit.*) produced evidence to indicate that the paralysis is chiefly central in origin. Cushny and Yagi,[10] Houssay[11] and Kellaway and Holden,[12] on the other hand, thought that the seat of motor paralysis was peripheral resembling very closely 'curare' action. Of late, evidence has been advanced that most, if not all, motor nerves on stimulation liberate acetylcholine at their ends and that this substance (and not the nerve itself) carries the impulse across the synapse to the end-organs. It has also been shown that this liberated acetylcholine is quickly destroyed in the blood due to the presence of a specific choline esterase in the plasma. Therefore, if acetylcholine is prevented from reaching the receptor end-organs by its destruction through choline esterase, apparently no

contraction of the muscles can take place, or in other words, a paralysis of the respiratory and other musculature will result. The paralysis resulting from cobra venom is generally considered to be due to a neurotoxin with specific action on the respiratory centre and nerve endings. In view of the recent ideas with regard to the chemical transmission of nerve impulses, it was considered of interest to study the effect of cobra venom on acetylcholine-choline esterase system of blood. It was expected that some light on the possible mechanism of action of the venom might be obtained from this angle.

The blood serum of the cat was used as the source of choline esterase. The continuous titration method of Stedman, Stedman and White[13] was employed for the determination of enzyme activity using acetylcholine chloride as the substrate. The original activity of the serum expressed as c.c. of 0·032 N. NaOH has been compared with the activity of the serum under the influence of cobra venom in various concentrations. A very striking activating effect of the cobra venom, on the choline esterase content of the serum was noticed, the activation increasing with the concentration of the venom. The Russell's viper venom tested similarly failed to show any measurable effect. This marked activation led us to suspect the possible existence of choline esterase itself in the cobra venom. The two venoms (Cobra and Russell's viper venom) were therefore tested for their choline esterase activity without the addition of the serum. Three different specimens of the cobra venom which were stored in the laboratory for periods varying from six months to two years (Table I) were tested for their choline esterase content and in all three, a very powerful choline esterase activity could be demonstrated, the most recent sample (six months' old) showing the highest activity.

The specific nature of the activity of choline esterase was studied by Stedman, Stedman and Eason[14] and by Stedman, Stedman and White (*loc. cit.*). They have shown that liver esterase is without any appreciable action on esters of choline and that choline esterase exerts little, if any, action on simple esters such as methyl butyrate. Roy[15] studied the rate of hydrolysis of ethyl

TABLE I.

Substrate : acetylcholine, 0·25 gm., in 100 c.c. ; Enzyme : dried venom 10 mg. Period of reaction 1 hour.

Experiment ..	1	2	3
Age of venom (in months) ..	> 24	12	6
Activity (in c.c. of 0·0231 N. NaOH)	4·70	21·80	41·10

butyrate in the presence of cobra venom and showed that in high concentration (5 per cent.) and under prolonged period of incubation, cobra venom had a fairly strong esterase activity while this activity was almost negligible in low concentrations (0·2 to 0·02 per cent.). In our experiment with 0·005 per cent. venom, no hydrolysis of ethyl butyrate occurred in 20 minutes incubation, while under identical conditions, a marked splitting up of acetylcholine chloride could be demonstrated. This goes to show that the esterase present in the venom is predominantly of the type of choline esterase. The well-known inhibitory effect of eserine on choline-esterase was also tested. Cobra venom when mixed with eserin (physostigmine) in a concentration of 1/50,000, lost its cholin esterase activity considerably, indicating that probably the choline esterase in the venom is of an identical nature with the esterase in the blood serum. Russell's viper venom, on the other hand, did not show any measurable choline esterase activity.

The biochemical and pharmacological significance of this finding is interesting. The presence of choline esterase in cobra venom offers a new and fairly satisfactory explanation of the peculiar toxic manifestations (paralysis) produced by cobra venom on biological tissues. Cobra venom, as is well known, is characterised by an action on the nervous mechanism. The choline esterase in the venom will, when introduced into the system, naturally supplement the activity of the choline esterase already present in the blood serum, and will help in bringing about a complete destruction of acetylcholine. Without the mediation of acetylcholine, nervous impulses will not be transmitted to the respiratory muscles and a paralysis will

supervene. This view-point, however, does not satisfactorily explain the specific paralytic effect of the cobra venom on the respiratory centre. It has not yet been conclusively demonstrated that impulses in the central nervous system are carried through the mediation of acetylcholine, though Dikshit[16] (1934) has demonstrated the presence of acetylcholine in the ventricles of the brain and suggested that humoral transmission may also occur in the central nervous system. Further work on the different aspects of this interesting problem is in progress.

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Composition of Fusel Oil, Mandya Distillery.

FUSEL oil is known to be of variable composition, depending upon the nature of material fermented, the kind of yeast and method of distillation. The fusel oil obtained during fermentation of Mandya molasses and subsequent distillation of spirits in the patent still, has hitherto had practically no demand in the market. It is of interest to know if any of its components can substitute imported products in varnishes and in other industries.

The fusel oil, sp. gr. 0·85, n_D^{27} 1·380, was distilled in a simple distillation flask when the propyl and *iso*butyl alcohols come over as binary aqueous mixtures (Table I).[1]

TABLE I.

Distillation of Fusel Oil.

B.P.° C.	Per cent.
78–86·5	11·8
86·5–87·5 ..	11·4
87·5–88	9·2
Water layer ..	2·5
88–89	11·9
89–96	11·4
96–115	7·0
115–120	2·5
120–125	4·6
125–132	27·7

About 800 g. of the oil were then dried repeatedly over anhydrous potassium carbonate and the dry oil fractionally distilled 4 to 6 times through Young's 4-bulb still-head. The specific gravities and refractive indices of the fractions were determined. The comparative optical rotation was observed with a sugar polarimeter in a 200 mm. tube (Table II). By oxidation of the fractions with potassium dichromate and sulphuric acid, oxidation products of the various alcohols were identified and *iso*propyl alcohol estimated (Messinger's method).[2] Ethyl alcohol was estimated by the method of J. Holmes, extracting the oil with brine and subsequent removal of the higher alcohols by petrol.[2] The presence of optically active amyl alcohol was denoted by the *lævo*-rotation of the higher boiling fractions.

TABLE II.

Fractional Distillation of Dry Fusel Oil.

B. P. Fraction	Per cent. Sample (*a*)	Per cent. Sample (*b*)	Opt. Rotn.	n^{27}_{D}	Sp. gr. 27
C°					
75–76	0·9	..	..	1·362	·7984
76–77	2·5	0·3	..	1·3625	·7989
77–78	4·4	4·5	..	1·363	·7995
78–79	5·3	5·4	..	1·365	·8019
79–80	1·5	4·3	..	1·366	·8041
80–82	3·4	7·4	..	1·368	·8076
82–85	1·5	3·7	..	1·371	·8097
85–90	1·2	2·5	..	1·375	·8095
90–95	3·5	0·6	..	1·3755	·797
95–100	3·8	0·9	– 0·7	1·382	·796
100–110	4·0	2·2	– 1·2	1·390	·7998
110–120	9·6	2·8	– 2·3	1·397	·7998
120–125	11·9	1·8	– 3·6	1·402	·802
125–128	27·1	40·6	– 6·8	1·4045	·8045
128–130	3·4	3·0	6·5	1·405	·805

The earlier alcohol fractions were not entirely dry, but the use of barium oxide for drying resulted in losses, due to its combination with some of the alcohols and also mechanical losses.

From comparative determination of the properties of alcohols (Merck's) with distillate fractions from two samples of fusel oil taken (*a* and *b*)—III—it is found that the fusel oil has the approximate composition:—water—18%; ethyl alcohol—8%; *iso*propyl alcohol—0·5%; *n*-propyl alcohol—18%; *iso*butyl alcohol—5·5%; *n*-butyl alcohol—6%; *iso* and active amyl alcohol—41%; *n*-amyl alcohol—3% and traces of free acids—0·01%.

It is seen that this fusel oil can serve as a source for the higher alcohols and for fairly large supplies of amyl acetate for industrial uses.

TABLE III.

Components of Fusel Oil.

	Per cent. Sample (*a*)	Per cent. Sample (*b*)
Water	16·0	20·0
Ethyl alcohol ..	7·8	8·0
*Iso*propyl alcohol ..	10·4	0·5
Propyl alcohol ..	16·0	20·2
*Iso*butyl alcohol ..	7·8	3·1
n-Butyl alcohol ..	9·6	2·8
Iso and active amyl alcohol	39·0	42·4
n-Amyl alcohol ..	3·4	3·0

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[1] *Distillation Principles and Processes*, by S. Young.
[2] *Alcohol*, by C. Simmonds.

Observations on the Liberation of Helium from Monazite by Heating.

THE preparation of helium from monazite is well known but as appreciable quantities of helium were required by us for our work on the adsorption of helium by charcoal (cooled in liquid air), several lots of monazite were heated under different conditions and the yield and rate of evolution of helium were studied.

The monazite employed was from Travancore, and it contained 7·2 per cent. of ThO_2. The main bulk (98 per cent.) of the naturally occurring material passed 40-mesh sieve and this was used for the heating experiments either in this condition or after crushing to 80-mesh.

The first set of experiments were carried out with a view to determine the temperature

and period for which the material available to us had to be heated in order to obtain a satisfactory yield of helium. The electric furnace used could be maintained approximately steady (± 10°) at temperatures up to 1,100–1,200° C. The purification of the gas obtained was effected as usual, the cocoanut-shell charcoal cooled in liquid air having been degassed previously in a Töpler vacuum by heating for over 24 hours in a bath of sulphur vapour. The measurement of the volume of helium was carried out in a constant volume burette[1] having two fixed glass pointers which corresponded to 2·742 c.c. and 9·380 c.c. respectively. The error in the determination of volume was not more than 1·5 c. mm. in any experiment.

As a result of several trials it was found that in order to liberate all the helium from the sample in a reasonably short period (4 hours), it was necessary to heat the material at a temperature of about 1,000–1,100° C. The quantities of helium obtained from the 40 and the 80-mesh samples were respectively 0·850 and 0·903 c.c. per gram of the material. The rate of evolution of helium when monazite is heated at 1,100° C. in a Töpler vacuum was studied, and the results of one typical experiment showing the quantities evolved during the progress of heating are given below:

Period of heating (in hours) ..	0—½	½—1	1—2	2—4	4—5
Helium obtained (percentage of total)	90·7	5·8	1·5	2·0	0·0

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July 29, 1938.

[1] *J. Ind. Inst. Sci.*, 1934, **17 A**, Part III, 36.

Spilitic Rocks from Chitaldrug, Mysore State.

IN a short paper published a few years ago,[1] the present writer gave a general petrographic account of the trap rocks of the Chitaldrug Schist Belt. The present note deals with the Jogimardi trap (the Chitaldrug grey trap of some writers), and the dark hornblendic trap of Chitaldrug.

The Jogimardi trap is a grey coloured, heavy basic rock. It exhibits a great variety of textures, varying from glassy and fine-grained types, to coarse rocks with ophitic or sub-ophitic textures. Sometimes, these rocks are also porphyritic. Augite, mostly altered to uralite and chlorite, and decomposed plagioclase, constitute the important minerals. The feldspars are invariably altered, but in a few favourable cases it was possible to determine that the refractive index was distinctly lower than that of Canada balsam; the species may therefore be referred to albite or acid oligoclase. Quartz occurs sporadically. Feebly pleochroic pale yellow epidote, and calcite are the common secondary minerals. Sphene and ilmenite are always present. These traps do not contain olivine or rhombic pyroxene.

The dark hornblendic trap is of a deeper colour than the Jogimardi trap, a character mainly due to the colour of the amphibole, which is deep-tinted with well-marked pleochroism from yellow to green to greenish blue. The feldspars are highly altered and so it is not possible to determine their exact nature. There is no augite in any of the sections examined by the writer. Magnetite, pyrites, and ilmenite occur as accessories. In a few cases, an ophitic texture is just discernible.

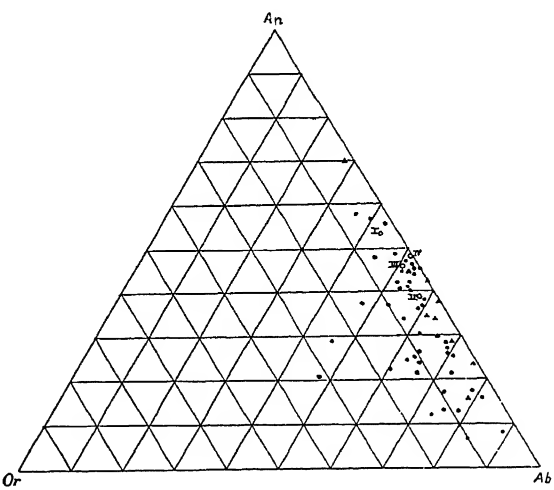

FIG. 1.

Molecular percentages of normative feldspars of spilites. British spilites are represented by triangles and the Chitaldrug rocks by circles. Spilites from other parts of the world are indicated by dots.

The chemical composition of these traps may be seen from the analyses given in the accompanying table. Columns I and II are analyses of Jogimardi traps, column III gives an average of I and II, and column IV is the analysis of a specimen of the dark hornblendic trap. Alongside these are placed, for purposes of comparison, the analyses of a few spilitic rocks from other parts of the world, as well as the composition of average spilite according to Wells and Sundius.

and a relatively high soda content, varying from 2.27 per cent. to 3·70 per cent. These are characteristic features of spilitic rocks, and in this respect, these rocks are comparable to the spilites from other parts of the world, though the percentage of soda is not so high as in the average spilites of Wells or Sundius.

The composition of the normative feldspars in these rocks is best seen by plotting the calculated molecules in an orthoclase-albite-anorthite triangle. This has been done

	I	A	B	C	II	III	D	E	IV	
SiO_2 ..	47·44	47·45	48·58	48·55	48·52	47·98	46·01	51·22	52·60	SiO_2
Al_2O_3 ..	16·28	17·54*	14·58	13·50	13·80	15·04	15·21	13·66	10·12	Al_2O_3
Fe_2O_3 ..	3·27	2·04	1·89	3·56	3·65	3·46	1·35	2·84	3·84	Fe_2O_3
FeO ..	9·76	7·44	7·65	10·20	9·83	9·79	8·69	9·20	12·73	FeO
MgO ..	5·20	6·72	6·36	7·37	5·88	5·54	4·18	4·55	6·17	MgO
CaO ..	11·22	10·96	9·80	8·58	10·92	11·07	8·64	6·89	9·36	CaO
Na_2O ..	2·94	3·93	4·02	2·94	3·70	3·32	4·97	4·93	2·27	Na_2O
K_2O ..	0·34	tr	0·43	0·32	0·32	0·33	0·34	0·75	tr	K_2O
TiO_2 ..	0·90	..	1·77	1·13	1·04	0·97	2·21	3·32	1·12	TiO_2
P_2O_5 ..	0·09	n.d	0·19	0·09	0·10	0·10	0·61	0·29	n.d	P_2O_5
MnO ..	0·18	n.d	0·46	0·27	0·14	0·16	0·33	0·25	0·03	MnO
H_2O ..	..	2·90	3·61	3·24	..	..	2·48	1·88	1·60	H_2O
Loss on ignition	2·19	..	..	..	2·12	2·15	..	..	..	Loss on ignition
Other constituents	..	0·55	1·29	0·16	..	..	4·98	0·94	..	Other constituents
	99·81	99·53	100·63	99·91	100·02	99·91	100·00	100·72	99·84	

* includes TiO_2.

I.—Jogimardi Trap, Chitaldrug, Mysore State. Analyst: E. R. Tirumalachar.
A.—Gwna Spilite, Bryn Llwd, Newborough Dunes, Anglesey. Analyst: J. O. Hughes (*Mem. Geol. Surv.*, 'Geology of Anglesey,' 1919, **1**, 74).
B.—Spilite, Mullion Island, Cornwall. Analyst: W. Pollard (*Mem. Geol. Surv.*, 'Geology of the Lizard,' 1912, 185).
C.—Greenstone, Valkeasiipivaara, Kiruna, Sweden. Analyst: A. Bygden ('On the spilitic rocks,' N. Sundius, *Geol. Mag.*, 1930, **67**, 6).
II.—Fine-grained Jogimardi Trap, Chitaldrug, Mysore State. Analyst: E. R. Tirumalachar.
III.—Average of Jogimardi trap analyses I and II.
D.—Average Spilite, according to A. K. Wells ('Nomenclature of the Spilitic Suite,' *Geol. Mag.*, 1923, **60**, 69).
E.—Average Spilite, according to N. Sundius (*Geol. Mag.*, 1930, **67**, 9).
IV.—Fine-grained dark hornblendic trap, Chitaldrug, Mysore State. Analyst: E. R. Tirumalachar.

It will be seen from the table of analyses that both these traps from Chitaldrug are characterised by a very low potash content (from just a trace in the dark hornblendic trap to 0·34 per cent. in the Jogimardi trap),

in the accompanying diagram, where the circles represent the composition of the normative feldspars of the Chitaldrug traps. It will be noticed that their positions correspond very well with the normative feldspars

of other well-known spilites, and fall within a narrow zone along the plagioclase line.

It is well known that spilitic rocks often show the characteristic pillow structure in the field. The recently reported occurrence of pillow structure[2] in the Chitaldrug traps is, therefore, of special significance as indicating the spilitic character of these rocks which must have originated as submarine flows.

Attention may also be drawn here to two rock types associated with the traps of this area, which have been described by the late Professor P. Sampat Iyengar[3] under the names Talvati felsite, and Anabur (or Pitlali) granite. By the courtesy of the Director of Geology in Mysore, the present writer examined a few specimens and slides of these rocks, and it was found that the Talvati felsite is a dark compact rock with sub-conchoidal fracture, containing abundant rounded or oval grains of quartz which appear almost black in colour, with a few small phenocrysts of feldspar. The rock weathers grey or greyish white. Under the microscope, the feldspars are seen to occur in individual crystals, glomeroporphyritic aggregates, and as minute grains in the matrix. The index of refraction and angles of extinction indicate an albite of composition $Ab_{95}An_5$. The quartz grains are invariably deeply corroded and embayed. Greenish biotite occurs in small shreds and flakes. Thin veins of epidote traverse the rock. This rock corresponds in most particulars to a quartz-keratophyre.

The Anabur or Pitlali granite which borders the Chitaldrug Schist Belt for more than fifty miles, is a gneissose rock containing albite of composition Ab_{92} An_8.

Keratophyres, quartz-keratophyres, and soda-granites are invariably associated elsewhere with spilitic rocks. Therefore, the presence in the Chitaldrug area of these sodaclase bearing rocks associated with the traps is yet another argument which supports the view that here we have a suite of rocks belonging to the spilitic series.

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July 28, 1938.

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[1] Pichamuthu, C. S., *Rec. Mys. Geol. Dept.*, 1930, **27**, 20–32.
[2] Raghunatha Rao, B. N., *Curr. Sci.*, 1937, **6**, 279.
[3] Sampat Iyengar, P., *Rec. Mys. Geol. Dept.*, 1905, **6**, 64, 86.

A Study of the Feldspars from the Mica Pegmatites of Nellore.

THESE feldspars comprise different types varying in composition and mineralogical properties. The most common of these is an albite with a Na_2O content of about 10 per cent. and an orthoclase with a potash content of about 16 per cent. In addition to these two main types there are also found appreciable quantities of perthites and microperthites, the most conspicuous of these being a beautiful green moonstone composed of a perthite-microperthite. A flesh-red microcline with typical microcline structure is also present in large quantities.

A quantitative study of almost all the main types of these feldspars was carried out both chemically and microscopically. The potash member in the flesh-red specimens of perthites and microperthites was found to be microcline, while in the other specimens, it was a moonstone of an orthoclase type. In the green feldspars the potash member is always green having very fine microcline twinning. The presence of this microcline twinning led to the common and erroneous view that this feldspar was microcline. But it differs from microcline in many of the essential optical properties. Sections cut parallel to *(001)* show straight extinction with reference to the trace of *(010)* cleavage. In addition, sections cut parallel to *(010)* show almost symmetrical interference figures in convergent polarized light. These observations show that it is not microcline but a moonstone of the orthoclase type. It is not anorthoclase as its sodium content was found to be very low. The microcline structure is perhaps an anorthoclase effect produced by that portion of albite which is in solid solution in the potash member.

Results obtained from chemical and micrometric data show definitely that mutual solubility exists between the *Or* (potash member) and *Ab* members on the one hand and *Ab* and *An* members of these feldspars on the other, whereas the *Or* and *An* members are not miscible. It is also noticed that *Ab* is more soluble in *Or* than *Or* in *Ab*.

The perthitic structure and the microcline twinning of these moonstones are not destroyed by heat, but continued heating at a tempearture of about 1000° gives rise to a change in the potash member at its contact with the albite member. The sharp contact

disappears and one notices a somewhat coarse area which does not extinct simultaneously with either of the feldsapar members.

Almost all the coloured feldspars, excepting the flesh-red ones, lose their colour on heating them to 300°. The green moonstone perthite changes into a pearl-white feldspar which retains all the original properties excepting the colour.

Though almost all the perthites examined exhibit the schiller phenomenon, the colours shown by them are not real schiller colours, but are produced by a metallic impurity, probably iron, which occurs as a ferrous compound in the green feldspars, and as a ferric compound in the flesh-red feldspars. In these feldspars no correlation could be found between the nature of the microperthitic structure and the colour, but the schiller behaviour which is always white in these feldspars is due to the microperthitic structure.

The flesh-red feldspars which contain the maximum amount of iron owe their colour to the microcline portion which holds numerous ferruginous vesicles distributed throughout its mass.

The green feldspars owe their colour to a green turbidity, probably due to a ferrous silicate which occurs as green cloudy patches within the body of the feldspars. Heated specimens do not show any special areas of turbidity. It appears therefore that the loss of colour is due to a change in the state of aggregation of the iron compound present in the feldspar.

In conclusion, I wish to express my heartfelt thanks to Dr. K. R. Krishnaswamy for suggesting the problem and for the valuable guidance given to me throughout the work.

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An Important Genetic Constant.

WORKERS on the inheritance of quantitative characters of the plants have all along been handicapped in obtaining rigidly true comparisons between the characters of the first hybrid progeny with those of subsequent generations, mainly due to the difficulty of obtaining a fairly large population of F_1 plants. In most cases workers had to depend on the insufficient data collected from a few plants of the F_1 and attempted to compare the same with data obtained from large populations of subsequent generations. The difficulty and labour involved in raising F_1 progenies every time when comparisons had to be made, have again forced a few workers to attempt comparing the data obtained in any one season with the data of F_1 collected in a different season under quite different environmental conditions. This, no doubt, is an erroneous procedure, since environment has a great modifying effect on the expression of any character, but it could not be helped.

The author of this note has for some time been thinking to find a way out and to determine a constant whereby it should be possible to predict the average value of any quantitative character in the F_1 from the average values obtained for that character in any particular year for the parents and the total F_2 population. For instance, if the average height or the tillering capacity in cereals of both the parents and the F_2 population grown under the same set of conditions are known, it should be possible with the help of a constant to gauge the average value of that particular character for the F_1 without the necessity of growing the F_1 at the same time. Taking the published data of several workers, and working out hundreds of them, it has been found possible to find that a definite relation exists not only between the parents, F_1 and F_2, but it also exists between the parents and any two successive generations. In all the cases worked out, it was found out that the sum of the averages of any quantitative character of both the parents and the F_1 was more or less three times the average for the F_2. It was also observed that the value of this constant holds good whether the average value of the F_1 was intermediate, more or less than either of the parents. Data obtained by East,[1] Hayes,[2] Shaw,[3] Engledow and Pal[4] are in entire agreement with the view expressed above. Data from other workers will be included in a subsequent paper. A few instances out of the data of the above-said workers are set forth in Table I.

TABLE I.

Cross between 1st Parents = A 2nd Parents = B	Character studied	Parent A	Average of Parent B	F_1	F_2	Constant K
1. 383 × 330 Tobacco	Corolla-Length in cm.	93·20	40·56	63·50	67·40	2·93
2. Cuban × Havana Tobacco	Number of leaves per plant	20·60	20·30	19·80	20·90	2·93
3. 80 × 5 Rahar	Height in cm.	251·00	320·62	255·91	276·85	2·99
4. Joss × Thule Wheat	No. of tillers per plant	100·00	62·00	133·40	96·00	3·08
Do.	Grain-yield per unit area	100·00	74·20	114·00	94·70	3·04
				F_2	F_3	
Do.	No. of tillers per plant	100·00	62·00	96·00	85·65	3·01
Do.	Grain-yield per unit area	100·00	86·36	84·70	89·34	3·00

It may also be mentioned here that once the value of the constant is known, it is possible to predict the values of F_3, F_4, etc. From the data of the parents and the F_2, taking A and B as the average values of the parents and 3 as the constant, it is now possible to say that $A + B + F_1 = 3F_2$; $A + B + F_2 = 3F_3$; $A + B + F_3 = 3F_4$ and so on.

The importance of this constant to plant-breeders is, therefore, self-evident and needs no further explanation.

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May 25, 1938.

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1 East, *Genetics*, 1916, **1**, 164–76.
2 Hayes, *Comm. Agr. Exp. Sta. Bull.*, 1912, **171**, 1–45.
3 Shaw, *Ind. J. Agric. Sci.*, 1936, **6**, 139–87.
4 Engledow and Pal, *J. Agric. Sci.*, 1934, **24**, 390.

Nitrogen Fixation in Relation to Weve-length.

IN publications by Dhar and Collaborators,[1] it has been shown that the addition of energy-rich substances to soil leads to fixation of nitrogen and that this type of nitrogen fixation is enhanced when the soil mixed with energy-rich materials is exposed to sunlight. These conclusions have been found to hold good in artificial bulb light also which excludes most of the ultra-violet rays.

Having obtained the definite evidence for the fixation of nitrogen in the artificial bulb light, the author has investigated the region which is most effective in bringing about the fixation and this note deals with the preliminary results obtained in this direction. Various light filters transmitting different regions of the visible part of the spectrum were used. 50 g. of well powdered garden soil was taken in a beaker, the sides and bottom of which were coated with Japan black to exclude light and allow light to pass only through the filters covering the top of the beakers. 25 c.c. of sugar solution containing 0·5 g. sucrose was added to the soil and mixed thoroughly and the mixture analysed for original carbon and nitrogen.[2] The soil was then exposed to light from a 1,000 watt bulb and the soil analysed again after an exposure of 300 and 400 hours. The following experimental results were obtained (Table I).

The results (Table I) are very interesting and important in that they show the region which is most effective in bringing about the fixation of nitrogen consequent on the addition of sugars to soil and exposure to light. It can be clearly seen from the table

TABLE I.

Original Analysis C : 0·575
N : 0·044.

Analysed after	Dark	Red 0·6–2·5 μ	Yellow 0·527–0·517 μ	Amber 0·4–0·75 μ	Dark blue 0·65– ·75 μ 0·3 –0·5 μ	Fl Yellow 0·55–0·20 μ	Sig Yellow 0·5–0·75 μ
300 hrs. C :	0·472	0·427	0·353	0·375	0·339	0·330	0·314
N :	0·045	0·045	0·050	0·050	0·051	0·053	0·052
400 hrs. C :	0·441	0·425	0·353	0·367	0·338	0·329	0·333
N :	0·045	0·046	0·044	0·044	0·044	0·049	0·045

that the maximum fixation was observed in the yellow region (0·55–2·0 μ).

Futher experiments are in progress to elucidate the real significance of different wave-lengths of light on non-symbiotic fixation of nitrogen.

The above experiments were undertaken in the Chemical Laboratories, Allahabad University, and the author's grateful thanks are due to Prof. N. R. Dhar for his generous help.

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May 3, 1938.

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[1] Dhar and Mukerji, *J. Ind. Chem. Soc.*, 1936, **13**, 155 ; *Nature*, 1936, **138**, 1060.

[2] Robinson, McLean and Williams, *J. Agric. Sci.*, 1929, **19**, 315.

Transgressive Segregation in Structural Hybrids.

THE modes of chromosome conjugations in structural hybrids lead to formation of new types of chromosomes (Müntzing, 1934;[1] Kostoff, 1935,[2] 1936,[3] 1937,[4] Darlington, 1937,[5] etc.). Breeding further such hybrids, one can produce forms with new karyotypes in homozygous condition. When such forms are crossed with the parental forms (species or varieties) new types of structural hybrids can be produced (*cf.* Kostoff, 1937*b*[6]), which might further give rise to new karyotypes.

Propagating the hybrids *Triticum vulgare* ($2n = 42$) × [*Tr. turgidum* ($2n = 28$) × *Tr. dicoccum* ($2n = 28$)] and [*Tr. vulgare* ($2n = 42$) × *Tr. monococcum* ($2n = 14$)] × *Tr. persicum* ($2n = 28$), I obtained in fourth, fifth and sixth generations several homozygous forms so far as the visible morphological characters and the time of flowering are concerned. One *Tr. turgidum*-like derivative ($2n = 28$) from the first triple hybrid and one *Tr. persicum*-like derivative ($2n = 28$) from the second triple hybrid were crossed. The plants obtained from this cross were structural hybrids, forming usually (1) one quadrivalent, or (2) one trivalent and one univalent, or (3) two univalents (Fig. 1), while

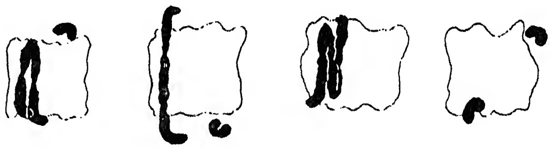

FIG. 1.

Four meiotic metaphases with trivalents, quadrivalents and univalents from the structural hybrid between *Tr. turgidum*-like and *Tr. persicum*-like derivatives. It does not seem that in all instances the same four chromosomes are involved, because I found in a pollen-mother cell two trivalents and two univalents.

the hybrids *Tr. turgidum* × *Tr. persicum* obtained from the normal species *Tr. turgidum* and *Tr. persicum*, which have participated in the triple crosses mentioned above, had normal meiosis.

The latter hybrids *Tr. turgidum* × *Tr. persicum* segregated in F_2 generation like intraspecific hybrids. In studying 303 (+ 6) hybrids in F_2 generation, I found that in respect to the characters : the length of the grains, the length of the awns, the breadth of the leaves, the number of the spikelets in the spike, and the pubescence on the nodes of the stem, no transgressive segregation takes place. Five F_2 plants out of

309 began to flower several days before the earlier parent (*persicum*), twelve plants began to flower several days after the late parent (*turgidum*) and six plants began to flower more than 10 days after the late parent. In other words, a noticeable transgressive segregation was only found in respect to the vegetation period.

The mode of segregation of the structural hybrids produced in crossing *Tr. turgidum*-like derivative with *Tr. persicum*-like derivative was quite different. I studied only 84 plants of this cross in F_2 generation. Three F_2 plants had much broader leaves than either parent. One of these plants had 18 mm. (16 to 20 mm.) broad leaves. Two plants had very narrow leaves reminding of those in *Lolium perene* and *Poa pratensis*. Three plants had much shorter awns than either parent. One plant had much longer grains than either parent. Two plants were dwarfs forming deformed spikes. One plant formed very narrow, but elongated spikes like those in *Agropyrum*. Three plants had less spikelets in the spikes and one had many more than the parental forms. I had also the impression that the hairs on the nodes of two F_2 plants were much longer than in *Tr. persicum*-like derivative. In respect to the flowering period five plants flowered earlier than the early parent and nine flowered later than the later parent. One plant did not form spikes at all, *i.e.*, it was a winter type. These observations show clearly that structural hybrids give a more striking transgressive segregation with broader amplitude than the normal (non-structural) hybrids. It is generally assumed, that transgressive segregation in normal hybrids is due to recombination of polymeric genes. When form $A_1 A_1 a_2 a_2$ is crossed with form $a_1 a_1 A_2 A_2$, F_1 hybrids $A_1 a_1 A_2 a_2$ and transgressive homozygous forms $A_1A_1A_2A_2$ and $a_1a_1a_2a_2$ are obtained. The same recombinations can take place in structural hybrids too. But in addition to these, another kind of phenomenon, namely, the exchange of segments between partially homologous chromosomes, makes the transgressive segregations more striking, involving many more characters. The mode of chromosome conjugations in structural hybrids create conditions for exchange of chromosome segments which leads to formation of gametes and further of zygotes and plants with gain (duplications) or loss (deficiencies, deletions or both) of chromosome segments. Consequently, the transgressive segregation in structural hybrids is due to polymeric genes and to chromosome rearrangements.

A very striking transgressive segregation was found in F_2 generation of a structural hybrid between *Tr. vulgare* (Novinka) and a *Tr. vulgare* type, derivative from wheat-rye hybrid. The transgression affected the breadth of the leaves, the number of the flowers per spikelet, the number of the spikelets per spike, the vegetation period (even winter types were segregated) and the length of the pubescent part below the spike. The wheat-rye *Tr. vulgare*-like derivative had hairs below the spikes, like *Secale cereale* covering a portion of about 1 cm. In F_2 generation I found plants, that had hairs immediately below the spike which spread down until 8–10 cm.

Intraspecific hybrids, between varieties originating from different geographical localities, might often be structural hybrids. They then segregate in the way described above, giving occasionally various kinds of abnormal plants. The mode of segregations of the varietal hybrids in barley described by Karpechenko (1934[7]) suggest strongly that he has obviously dealt with structural hybrids. Liepin (unpublished) observed recently a similar type of segregation from a cross between two varieties of *Tr. durum*, one (*arraseita*) originating from Abyssinia. His hybrid has probably been also a structural hybrid. I studied cytologically two hybrids between *Tr. persicum* var. *stramineum* and *Tr. durum*. In one of them var. *arraseita* has participated while in the other one Mediterranian form of *Tr. durum* was the component. The hybrid with the Mediterranian variety had normal meiosis, while the hybrid with *Tr. durun arraseita* was a structural hybrid forming polyvalents and univalents.

Broad amplitudes of transgressive segregations of structural hybrids are of great practical value. Plant-breeders usually attempt to produce transgressive forms in respect to various quantitative characters, by varietal hybridisations. The offsprings of structural hybrids represent in this respect populations with more desirable forms. *Progenies of structural hybrids have also great evolutionary significance.* (1) The populations derived from structural hybrids have greater diversity of forms and offer a more abundant material

for natural selection. (2) Structural hybrids have various degrees of reduced fertility. Plants with new homozygous karyotypes, that originate from structural hybrids, will be partly isolated and might get further differentiated into separate forms.

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Institute of Genetics,
Academy of Sciences of U.S.S.R.,
Moscow,
June 27, 1938.

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On a New Species of *Isoetes* in India.

THERE is a wide-spread belief amongst the botanical circles in India, that *Isoetes coromandelina* L. is the only species of that genus occurring in this country.[1] This is largely due to the fact that all the specimens collected at different places by various workers[2] happened to belong to that species. In October 1935, however, I came across a small form of *Isoetes* at higher elevations in the Sahyadris, which on critical examination turned out to be a new species. The object of the present note is to give a short account of this new Indian species of *Isoetes*.

Type Characters.

Corm 3-lobed, small, without sheaths; leaves 7–15, 7–20 cm. long, slender, cylindrical and dark green; stomata numerous on the upper part of the leaf; air chambers 4; *peripheral strands none*; ligule cordate, slightly lobed on the flanks; sporangium 2 mm., more or less round, *covered by a complete velum leaving only a slit-like aperture at the base*; megaspores 325–430 μ in diameter, cream coloured when dry, dark brown when wet, studded with large uneven tubercles particularly on the lower facet; commissural ridges prominent; microspores 30 μ in diameter, marked with small spines; plants ambisporangiate.

Occurrence—"The mountain lake on the table-land at Panchgani (Bombay Presidency), 4,500 ft. above the sea-level."

"In pondson the grassy tops of the Kalahattigiri, Baba Budhangiri and other peaks of Sahyadris in the Mysore State."

Habit—"Occurring at the close of monsoons on the margins of ponds in the midst of what may be called *Ammania-Eriocaulon* association."

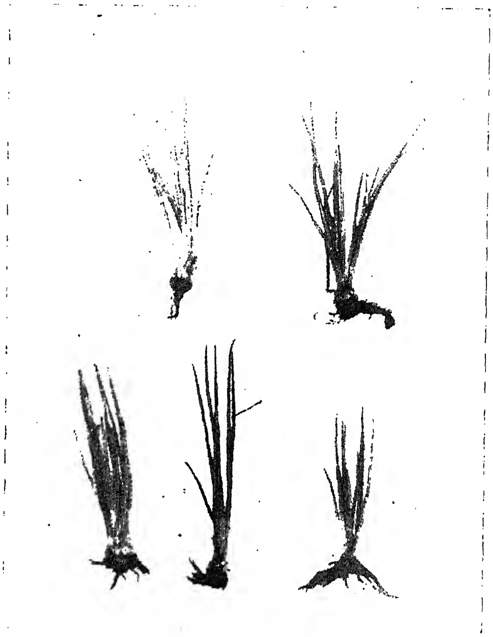

FIG. 1.

Systematic Position.

The species belongs to the group "*Subaquaticæ*" of Baker[3] and to the group "*Tuberculatæ*" of Pfeiffer[4]. It is closely allied to *I. alpina* Kirk[5] from New Zealand and *I. Muelleri* A. Br.[6] from Australia; but it differs from them in size and markings of the megaspores, number and the length of the leaves and the shape of the ligule. As it does not totally agree with both these species in such important diagnostic features, and again as it is separated from them by a wide geographical gulf from both of them, it is better to separate it from them. Accordingly it has been separated and provisionally called *Isoetes Sahyadrii* sp. nov.*

* *Isoetes Sahyadrii* Mahabale, sp. nov. Cormus trilobatus, parvulus, sine vaginis; folia numero 7–15, longitudine 7–20 cm., angusta, cylindrata, fusco viride; plumeris stomatibus instructa in superiore facie folii et quatuor aeris cellis et fibrosis periphericis nullis. Ligulæ cordatæ leviter lobatæ ad latera. Sporangium plus minusve rotundum, 2 mm. undique velo coopertum præter levissimam reticulam prope basim. Macrosporæ diam. 325–430μ, gilvæ qum sunt aridæ, fuscæ fulvræ si madefactæ sunt, tuberculis crassis horridis ornatæ præcipue in inferiore latere, costis commissuris prominentibus. Microsporæ longitudine 30 μ, instructa spinulis: plantæ ambisporangiatæ.

The type specimens[7] are deposited in the Department of Biology, Gujarat College, Ahmedabad (India).

T. S. MAHABALE.

Department of Biology,
Gujarat College,
Ahmedabad,
July 18, 1938.

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[3] Baker, *Fern Allies*, 1887, 123–34.

[4] Pfeiffer, N. E., *loc. cit.*, 104.

[5] Pfeiffer, N. E., *loc. cit.*, 122; Baker, *loc. cit.*, 127.

[6] Pfeiffer, N. E., *loc. cit.*, 127; Baker, *loc. cit.*, 127.

[7] The specimens of this new species were first exhibited at Calcutta on 7-1-1938 at the Botanical Exhibition held on the occasion of the annual meeting of the Indian Botanical Society.

Osteological Abnormalities in *Rana tigrina* Daud.

MANY cases of osteological abnormalities have already been described in frogs. Thus, for example, Boulenger,[1] amongst other individual variations, records an interesting, anomalous mode of articulation of the vertebræ in the Pelobatid frog *Xenophrys*. Adolphi[2] describes abnormalities in the vertebral column of *Bufo variabilis*. Bateson[3] recapitulates and discusses vertebral variations described by such previous authors as Goette,[4] Camerano,[5] Bourne,[6] Howes,[7] etc. Nicholls,[8] while describing the normal structure of the urostyle in *Rana tigrina*, gives an account of certain variations in it. Rao[9] mentions the abnormalities in the girdles and femur of *Rana tigrina*. Noble[10,11] remarks on the deviations found in the vertebral column of certain Anura. Thirumalachar[12] comments upon a unique case of the segmentation of the urostyle in *Microphyla rubra*, and also describes the fusion of certain vertebræ with each other and with the urostyle in *Rana hexadactyla*.[13] Raichoudhry and Das[14] describe the malformations in the vertebral column of *Bufo*. Ramaswami[15,16] notes the vertebral variations found in *Rana curtipes*, *Rana temnuilingua*, and *Megalophrys major*. Zaharesco[17] reports on the numerical variations in the vertebral column of *Rana esculenta*; and Remane[18] sums up the individual variations in the number of vertebræ of some Anurans.

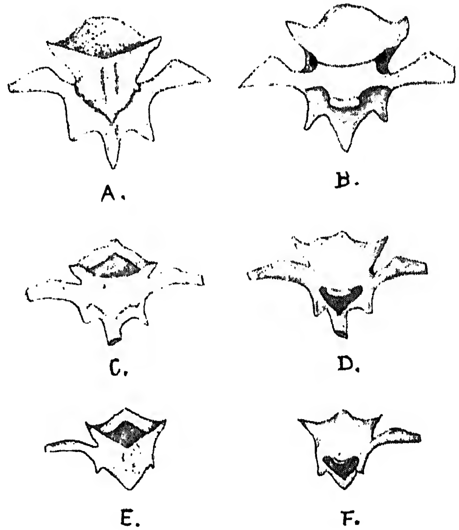
In the present article are described some interesting cases of abnormalities, found during the course of a careful examination of over a hundred skeletons of the common bull-frog *Rana tigrina*. Such abnormalities are obviously very rare, and some of the present ones, at any rate, are being described for the first time.

VERTEBRAL ABNORMALITIES.

I have come across seven cases of fusion of successive vertebræ: three between the first and the second vertebra, one between the fifth and the sixth, and three between the eighth and the ninth.

(*a*) *Fusion between the first and the second vertebra.*—Of the three cases of fusion between the first and the second vertebra, one (Text-Fig. 1, *A* and *B*) resembles the normal condition very closely, the only difference being that instead of the intervertebral articulation, there is an immobile junction between the two. The line of demarcation between the fused vertebræ is distinct all round, and the intervertebral foramina are present as usual.

In the second case (Text-Fig. 1, *C* and *D*), the fusion is more complete, and the demarcation between the two vertebræ has entirely



TEXT-FIG. 1.

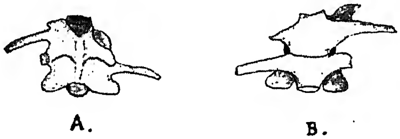
Abnormalities of the first and the second vertebra.
A, *C*, *E*—dorsal views; *B*, *D*, *F*—ventral views.

disappeared except for a slight indicating depression on the dorsal side. The intervertebral foramen on the left side is absent, while on the right there is a narrow pit superficially just anterior to the transverse process, and a similar depression inside the neural space. Correlated with this absence of the intervertebral foramina, there must have been an abnormality in the first pair of spinal nerves: these might have been absent, or might have emerged between the second and the third vertebra instead of between the first and the second.

In the third case (Text-Fig. 1, *E* and *F*), the fusion is the most complete, and the two vertebræ have become a single entity, with no separating lines visible on any side. The intervertebral foramina have disappeared, leaving not the slightest trace, and even the transverse process is totally absent on the right side.

Arranged in a series, the three cases show a gradual process of compacting between the atlas and the axis, so that the proportionate antero-posterior length is the maximum in the first case, and the minimum in the third, the proportion being like the normal, unfused ones in the former case.

(*b*) *Fusion between the fifth and the sixth vertebra.*—I have discovered only one case of this type (Text-Fig. 2). The fusion is quite complete, although the joining surface is



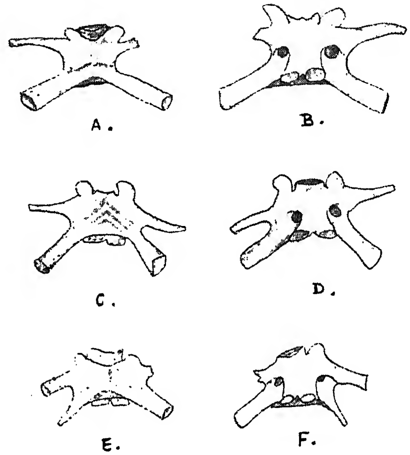
TEXT-FIG. 2.

Abnormal fifth and sixth vertebræ.
A—dorsal view : *B*—ventral view.

distinct all round. The intervertebral foramina are present, but the neural spines have fused together so that a groove-like depression alone distinguishes the place of fusion. The right transverse process of the fifth vertebra and the left one of the sixth are broken near their roots.

(*c*) *Fusion between the eighth and the ninth vertebra.*—I have found three cases of this kind of abnormality, and in all of them the fusion is complete.

In the first case (Text-Fig. 3, *A* and *B*), the two component vertebræ, which have compactly come together, do not show any special abnormality. The transverse process, the intervertebral foramina, the anterior



TEXT-FIG. 3.

Abnormal eighth and ninth vertebræ.
A, *C*, *E*—dorsal views ; *B*, *D*, *F*—ventral views.

facet of the eighth vertebra and the posterior one of the ninth are normal. The fusion, however, is so complete that it is difficult even to distinguish the joining zygapophyses of the two vertebræ from each other, there being only a small nodule-like projection in their place.

The second case (Text-Fig. 3, *C* and *D*) is, to all intents and purposes, a replica of the first. Here, however, the right transverse process is directed not straight outwards as is the case in a normal skeleton, but obliquely backwards, nearly parallel to the transverse process of the ninth vertebra, an arrangement perhaps to give additional support to the ilium of this side.

In the third case (Text-Fig. 3, *E* and *F*), there are several features of interest. The two vertebræ have very compactly grown together and the bilateral symmetry is apparently disturbed. Not only is the hollow anterior surface of the centrum of the eighth vertebra placed obliquely, but the transverse processes also are irregularly developed. On the right side the normal arrangement is visible as the transverse process of the eighth vertebra (distally broken) is slender and the posteriorly-directed transverse process of the ninth vertebra is stout having evidently served for the attachment of the ilium. On the left, however, it is the transverse process of the

eighth vertebra (and not that of the ninth) which is stoutly formed and is adapted for ilial articulation. The left transverse process of the ninth vertebra is slender in build and abnormal in direction, being pointed obliquely backwards and downwards.

The causes of such abnormal fusion of successive vertebræ are not quite clear. It appears, however, that these abnormalities are in some way related to the points of greater strain on the backbone in the movements of the animal. The fusion occurs more commonly either between the first two or the last two vertebræ and is extremly rare between the middle vertebræ. The leaping of the frog puts an exceptional stress on the ninth vertebra with which the pelvic girdle is connected and thus this vertebra may be occasionally reinforced by fusion with the one preceding it. Similarly, the movements of the head put a stress on the first vertebra, with which the second is often fused.

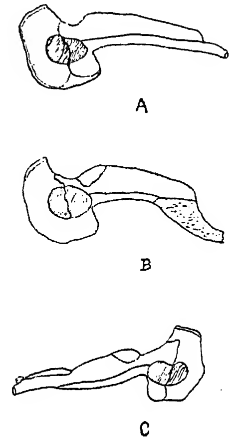
In this connection it might be mentioned that Koch[19] and Ruckes[20, 21] lay a great emphasis on the interpretation of the vertebrate skeleton on the basis of the laws of mechanics, more particularly on the determination of the stresses present on certain bones.

The phenomenon of vertebral fusion is a common feature in certain other Anura and it is believed that the limited number of the presacral vertebræ in this group has arisen through this phenomenon. Remane[22] in this connection says that in the Aglossa, *Atelpous* and in other genera (*Pelobates*) vertebræ $1+2$ grow together as an individual variation, in *Hymenochirus* also $7+8+9$, in *Dendrobates typographus* and *D. tinctorius* $2+3$ and $8+9$, in a few other species of this genus $1+2+3$ and $8+9$.

ABNORMALITIES OF THE PELVIC GIRDLE.

Two cases of abnormal development of the pelvic girdle have come to my notice and both refer to the form of the ilium. The first case (Text-Fig. 4, *B*) concerns the left ilium while the second concerns the right. In the former, this bone instead of ending anteriorly in a straight cylindrical extremity, possesses a large downwardly-directed process, the shape of which is clear from the figure. In the latter, the ilium is not straight but irregular in direction and shows a point midway at which it is angularly bent outwards. The ridge is uneven and ends anteriorly in a rounded bony prominence.

Both these cases might have been due to fracture and regrowth of the ilia, although it is difficult to be certain about it.

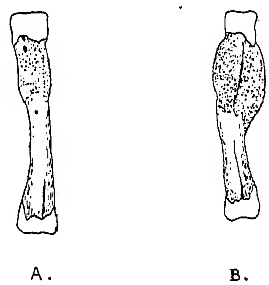


TEXT-FIG. 4.

A—Normal pelvic girdle from right side ; *B*—Abnormal pelvic girdle—right side ; *C*—Abnormal pelvic girdle—left side.

ABNORMALITIES OF THE TIBIO-FIBULA.

Three cases of abnormality of tibio-fibula have come under my observation ; two of the right, and one of the left. Of the former, one (Text-Fig. 5, *B*) showed a very large



TEXT-FIG. 5.

Abnormal Tibio-fibula.
A and *B* are different specimens.

irregular, granulated dilatation from its middle up to the distal epiphysis ; and the other showed a similar one, less marked, almost smooth, and reddish in appearance. The left (Text-Fig. 5, *A*) abnormal tibio-fibula has also a dilatation like the first right one although not so extensive. All three cases

may be due either to the fracture of the bone during life, or to its necrosis.

I should like to express my deep sense of gratitude to Mr. Beni Charan Mahendra, whose continuous guidance and help has made the present work possible. I am also indebted to Dr. Baini Prashad for the loan of two journals and to Dr. L. S. Ramaswami for a typed copy of Dr. Thirumalachar's paper.

MAHESWAR SINGH SOOD.

Department of Zoology,
St. John's College,
Agra,
May 20, 1938.

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Coxal Interlocking in the Lepidopsocidæ (Copeognatha) and its Probable Taxonomic Value.

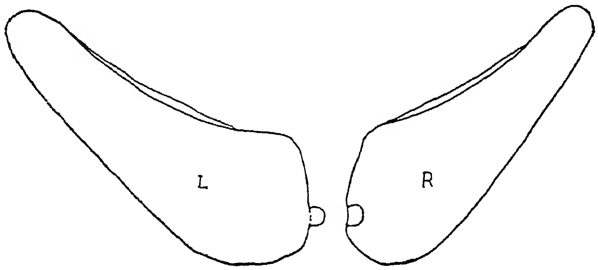
MORPHOLOGICAL studies made on some Indian Copeognatha enable me to record a curious coxal interlocking arrangement, which I believe has not yet been observed among insects. This arrangement occurs in four new species of Lepidopsocidæ belonging to four different genera. One is a species of *Thylacopsis*; another, of *Lepidopsocus*; the third, an *Udamolepis*; the fourth cannot be assigned to any of the existing genera and is therefore placed in a new genus, *Mediosoa*.* In the natural position, when observed from the ventral side, the meso-coxæ of these insects appear to be somewhat buttoned up together. On closer scrutiny it is found that a condylelike protuberance on the inner side of the left meso-coxa fits exactly in a corresponding cup-shaped cavity on the right meso-coxa.

It is surmised that by this ball and socket interlocking device the meso-coxæ can be made to move together as if they form a single piece. This arrangement must obviously be meant for jumping. It has been observed that these insects ordinarily move about by walking, but when disturbed they take recourse to hopping. This behaviour is not surprising since their wings are degenerate and useless for flight.

There is not sufficient record yet available to show in which genera of the family Lepidopsocidæ this coxal arrangement is present. Pearman observed such an arrangement in a specimen of *Soa*. It is not found in a species of *Lepolepis* which I possess and also in *Lepidila kellogi* Rib. which has been examined by Pearman. It is quite probable that this arrangement is absent

* The detailed descriptions of these species will be given in a subsequent contribution.

in other species of *Lepolepis* and *Lepidilla* as well. From a study of the various characters of the family Lepidopsocidæ and



Meso-coxæ of *Medinoa*, Gen. et sp. n.

the occurrence of this coxal arrangement in some species, I am inclined to believe that this family consists of two natural groups which may be assigned sub-family ranks and easily separated.

Before concluding I wish to record my sincere thanks to Dr. C. J. George for kindly going through the manuscript and offering his much valued suggestions and criticisms.

M. G. RAMDAS MENON.

Department of Biology,
Wilson College,
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June 29, 1938.

Sulaiman's Predictions.

To my article published in *Current Science*,[1] Prof. Madhav Rao has added a reply.

1. The first objection is as to the title of my article, and he has suggested that it savoured more of personal advertisement than of a genuine scientific controversy. I was replying jointly to two different criticisms, the second of which had not even initials appended to it; and both of which were directed against my predictions. I chose a title which was applicable to both and, I maintain, was appropriate. When I am challenging the theory of the greatest Mathematician of this century, I am not at all ashamed of advertising my predictions, one of which has already received a remarkable confirmation and the result of the second is still awaited. As to the third, the performance of an experiment is being looked for.

2. Replying on behalf of Sir C. V. Raman, Prof. Madhav Rao has taken objection to my submission that according to my theory the excess of the deflection of light over Einstein's value should be at least 33 per cent. He has called it so indefinite as scarcely to be taken seriously. Apparently Prof. Madhav Rao has forgotten the reply which I published to his criticisms of my theory in *Current Science*.[2] Perhaps the reason is that on that occasion he had not taken up my challenge to reply separately to the 60 points which I had numbered serially, but he contented himself with certain general remarks only. It was pointed out by me there that the upper maximum value of the deflection of light is 3/2 times Einstein's value. When the two limits have been fixed, there is no indefiniteness at all. He has also overlooked what I pointed out on p. 458 of my last reply that owing to certain deficiency in measurement and omission of a correction the value increases gradually as one proceeds from the limb farther away.

3. Prof. Madhav Rao has quoted in italics Dr. Royds' conclusion that the Relativity theory or any other theory requiring a general displacement of solar wave-lengths is not adequate to furnish a complete explanation of solar displacements. I am glad that Prof. Madhav Rao admits that the Relativity theory is not adequate to furnish such an explanation. As to my own theory it is not at all clear whether Dr. Royds ever had it in his mind, as there is certainly no reference to it in his paper, much less to my point that to test the value a curve should be drawn for the difference between the spectral shift at different points and that at the centre for lines of equal intensity.

4. Prof. Madhav Rao imagines that I had misunderstood Evershed's reference to the hypothetical observer on the planet Pluto and explains that Everhsed had used the illustration to emphasize that Relativity gives a satisfactory explanation of the solar spectral shift "in a general sort of way". If all that Relativity can claim is an explanation *in a general sort of way*, it will have to admit defeat. As a matter of fact the critic has himself misunderstood my point altogether. In text-books on Relativity the value of the spectral shift of light from Sirius B has been claimed as a brilliant triumph of Relativity. That is what I was

refuting when I said that were we at Sirius wherefrom the solar shifts from the centre and the edge would be indistinguishable, we could persuade ourselves to be convinced of a brilliant triumph of Relativity. I would certainly have suggested an observer in the Andromedia Nebula wherefrom the solar system itself would not be seen if any champion of Relativity could have claimed any brilliant triumph on account of the spectral shift from such nebula, apart from the now exploded "Expanding Universe".

5. Prof. Madhav Rao thinks that I regard every failure of the Relativity theory as a triumph for my own. I certainly regard every failure of the Relativity theory as a triumph for me because it falsifies the postulates which I have repudiated. I believe that when such failures are demonstrated, the new generation of Mathematicians and Scientists, no longer overawed by authority, would unhesitatingly reject such postulates as that the finite velocity of light relative to any moving body howsoever fast it may be moving and no matter whether light be overtaking it or receding from it, is always the same, or that the time taken by light to come from one nebula to another would be exactly equal to the time taken by light to come from the second to the first, even though both the nebulæ be moving forward in the same direction with tremendous velocities.

6. Prof. Madhav Rao still relies on the remark of Dyson and Wolley that Einstein's prediction had been verified, and has ridiculed my suggestion that their remark had been misunderstood. I had quoted word for word the remarks of Dyson and Wolley to show what they could have meant by the supposed confirmation. The quotations speak for themselves, and establish no more than that the value is nearer Einstein's than Newton's, and also admit that it is certainly much more than Einstein's theoretical value. I also pointed out that these learned astronomers published their book before Royds' results were known, and therefore made no reference at all to the failure of Relativity as regards the spectral shift at the edge. So far, the misfortune has been that there have been only two theories in the field—the Newtonian and the Einstenian, and therefore astronomers have been content to take the minimum possible value for the deflection of light so as to establish that the Newtonian value is wrong and have felt quite satisfied with such a result. Now that I have propounded a third theory, which makes the value larger than had been ever before imagined, future astronomers, may, in making their calculations also see what the maximum possible value of the deflection of light can be. I now hope that observations will no longer be brought down to the minimum possible value on account of existing prejudices in favour of Einstein's theory.

7. Lastly, Prof. Madhav Rao has remarked that my theory has not yet been developed in a comprehensive manner and is a mere tinkering, and until it produces some striking achievements compelling its acceptance it cannot throw overboard such an eminently successful and philosophically satisfactory theory as Relativity.

I claim that I have already covered the entire ground of the General Relativity Theory so far as it can be tested by astronomical observations, and my next paper which is now ready will unify Gravitation and Electricity completely. As to Relativity being "eminently successful and philosophically satisfactory" I may better quote Prof. Madhav Rao's later opinion in his own words "The final conclusions (of Augstine Sesmat) are that for the present it would be as unwise to declare the relativity theory true and definitive as it is to declare it false and indefinite; and that from a philosophical point of view the doctrines must be taken with great care—*conclusions with which one could certainly....agree*.[3]" It may surprise the learned critic when I say that I am not at all anxious that my theory should be accepted quickly. The delay gives me time to develop my theory in annual vacations, which a more competent and whole-time mathematician may be able to accomplish in a shorter time.

S. M. Sulaiman.

Federal Court,
Delhi,
August 1, 1938.

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[1] *Curr. Sci.*, 1938, **6**, 457.

[2] *Curr. Sci.*, **4**, 1937, **6**, 397.

[3] *Curr. Sci.*, 1938, **6**, 516.

REVIEWS.

Grimsehl's Lehrbuch der Physik, neubearbeitet von Prof. Dr. R. Tomaschek. Zweiter Band/Zweiter Teil: Materie und Äther. 8th Edition, revised and enlarged. (B. G. Teubner, Berlin and Leipzig), 1938. Pp. viii + 456 with 339 Textfigures. Price 14 R. M.

That a new and improved edition of this well-known text-book should appear after a lapse of less than two years is a very good indication of its popularity. A perusal of the book brings the conviction that this popularity is well-deserved. The structure of matter and the interaction between matter and light, or what is usually termed "Modern Physics" is the subject of the volume. The treatment lays stress on the experimental facts and technique, every-day applications being described wherever possible. The arrangement is such as to lead naturally and unambiguously to the theories that explain these facts. The presentation is lucid, and the whole outlook is modern and organically logical. The illustrations give unalloyed delight and add to the clarity of the text. Mathematical detail is only sparingly included so that even a Pass student can follow the subject easily, but the extent of the information is vast enough to suffice even for M.Sc. students, at least on the descriptive side. Wave-mechanical explanations occur side by side with those based on the vector model and the treatment of atomic and molecular spectra is admirable. Besides a general revision in the light of recent knowledge, the new edition includes sections on atomic transmutations and on atmospheric electricity. Some features of the book, however, strike one as very unusual. One of these is the extraordinary amount of space devoted to the exposition of the work and the views of Lenard. Another is the dismissal of the Theory of Relativity with the remark that it is not necessary to go into details regarding this "dogmatic didactic method". General Relativity is not at all mentioned, while all the experiments which are usually supposed to support the Special Theory are here described in detail, but interpreted from the point of view of an "Uräther". Even the mass equivalent of energy is deduced in a special way due to Hasenöhrl and Lenard. Gravitational bending of light and the red-shift of spectral lines are also explained in accordance with Lenard's views. An impartial consideration of the present situation shows that neither the Relativity Theory nor Quantum Mechanics have succeeded in removing the contradiction between the corpuscular and wave aspects of light and matter, or in elucidating the relation between electromagnetism and gravitation. But the methods developed by the Relativity Theory and Quantum Mechanics have proved themselves to be powerful tools, and although they lack "anschaulichkeit", and although the philosophical speculations based on them may not stand the test of time, we feel that further advance will not be divorced from those methods. Accordingly a falling back on special arguments and conceptions to prove results recognized to be first obtained by those methods seems to us to be a backward step. Apart from this feeling, we have nothing but admiration for the book before us, and we heartily recommend it to all students of Physics.

T. S. S.

A Text-Book of Physics. By Spinney. (Macmillan & Co.), 1937. Fifth Edition. Pp. 721. Price 16/-.

A text-book which has been current since 1911, and which has now reached its fifth edition, must clearly have established itself in popular favour, although it is not well known in India. The book is "designed for use as a text in courses offered to university and college students," but only at an elementary level. No more demands are made on the mathematical prowess of the reader than a little algebra and trigonometry, and even the latter is explained in an appendix.

The main subjects occur in the order: Mechanics, Heat, Magnetism and Electricity, Sound, Light. A very wide range of topics is covered, including many modern advances. Indeed in some places the topics change so rapidly that one feels a fuller treatment, even at the expense of the omission of some items, would be preferable. The diagrams are excellent, and many problems are

provided for the student in addition to those solved in the text.

It is good to find proper emphasis laid on vectors; also that angular motion is discussed side by side with linear motion, with a comparison of the corresponding quantities. The gyroscope is introduced but is suffered to remain rather mysterious; one would wish to see a somewhat fuller explanation by the vector model. In optics, a convention of signs is used which makes real rays positive and virtual rays negative. This convention was recommended in the Physical Society's report on the subject a few years ago. It leads to the same equation $1/p + 1/q = 1/f$, for all spherical mirrors and lenses, and is by far the most convenient convention for teaching purposes. The sooner it comes into general use the better. The author adopts this convention, but for some reason on p. 614 he proves a different formula for negative lenses. It would be better to start with the convention and then develop the formula, in all cases, in accordance with it.

The author defines the specific gravity of a body as "the ratio of its density to the density of water at the same temperature". This is certainly not what we measure with a hydrometer, and if the foregoing definition were accepted the specific gravity of a body would change with temperature even when its density remains constant. Surely the accepted term for such a ratio (if ever we require it) is "relative density". The reviewer has urged before that the term "specific gravity" should be used (as it is used by eminent continental physicists) in its proper original sense of specific weight, or weight per unit volume; just as density is specific mass, or mass per unit volume. Similarly specific heat (p. 221) should take its place as a respectable physical quantity, calories per gram per degree, and not as a ratio of two quantities both of which vary.

In the Introduction to Heat, there is some lack of logical connection. The fact that mercury expands uniformly is not a reason for, but a consequence of, its choice as a thermometric substance. In the discussion of radiation, and elsewhere, the ether receives more attention than an extinct concept really deserves. It should be made clearer that the ether is simply a temporary aid to the imagination, like the electric fluids.

It is, perhaps, time that some of the old phraseology should disappear. A case in point is the "ice-pail" experiment, it is after all immaterial what kind of bucket Faraday used. Students sometimes wonder why the ice-pail experiments can be done without ice, especially when there is an ice-calorimeter which requires it. With regard to general style, one's only criticism would be that 'evidently', 'it is evident that', and similar phrases, occur so frequently as to be irritating.

The book is clearly written and is very readable. The printing and production are all that could be desired. In the whole it forms an excellent introduction to the study of Physics, and may be recommended with confidence.

H. J. T.

The Fine Structure of Matter: Part II.—Molecular Polarisation. By C. H. Douglas Clark (Chapman & Hall, Ltd., London), 1938. Pp. 217–457 + lxxii. Price 15*s*.

The Debye theory of polarisation, Fajan's theory of deformation, and the derivation and meaning of dipole moments form the leading themes in this volume. The subject-matter is grouped under five chapters, (i) Dielectric Constants, (ii) The Debye theory of Polarisation, (iii) Molecular Refraction, (iv) Polar Molecules and (v) Molecular fields. In the preface, it is said that "the book is designed to cover the period up to that surveyed by *Science Abstracts* (Physics) of January 1935". But the book bears the date 1938 on its title page, which is very misleading, particularly as no endeavour has been made to bring the volume up to date to the time of publication. Unfortunately for the author some very significant advances in the subject have been made just during this interval, and thus the delayed publication has detracted the book from its legitimate value.

Even otherwise the book is rather disappointing. It purports to be a "Comprehensive treatise". Such a treatise should be more than a mere classified catalouging of all the references say, that appear in the *Science Abstracts*. One expects a critical evaluation, the older works being given their proper place, and the more significant results emphasised. But in this volume under review all available references

are apparently thrown in. The result is that one frequently meets with a series of disjointed statements, such as, to give just one example the last two paragraphs of Section 32 (p. 285, 286). Sometimes even references totally unconnected with the topic are included, such as that in p. 275 to Meyer's paper on the *internal* free rotation in a molecule in a paragraph dealing with the rotation of molecules *as a whole*, their relaxation time, and the anomalous dispersion of dielectric constant.

Mainly on account of the book being too late by four years, the treatment of a number of topics will be found to be very inadequate; thus, *e.g.*, compare the brief single paragraph on "Solvent Influence" on p. 340, with the whole section on the same subject covering 17 pages in the Chemical Society *Annual Reports* of 1937.

It serves no useful purpose to point out various other minor errors in the book, but protest must be made against particularly two features: (1) the extraordinary way of drawing the curves of Mol. Polarisations against f_2 in pages 336–38, etc. with f_2 values along the ordinate, and (ii) the tantalising abbreviations adopted for the names of well-known scientific journals. While it is conceded that there is no universal agreement on these abbreviations yet within a certain margin, the abbreviations adopted are intelligible to the reader. But those used in these series of volumes constitute a challenge to the guessing powers of the reader: try for instance what the following items stand for; J.P., P, Pa, V, R, G and B.B.S. It would have been far better to number the journals arranged in an alphabetical order, and to use these numbers. The reader will then immediately refer to the Index, without first trying and then fieeling disappointed that the letters give no clue to the identity of the journal.

The subject-matter of the book covers only 240 pages, while no less than 72 pages are occupied by tables of contents and indexes for the previous and subsequent volumes in this series. Also needlessly thick paper is used for the book, but the printing and binding are up to the good standards of the publishers.

On the whole, the volume under review judged with reference to the subject it deals with, cannot be said to be an useful addition to the list of books on the subject. It may serve however as a fruitful source of information on the varied literature up to 1934.

M. A. G. RAU.

Food for Starving Millions of India. Food Planning for Four Hundred Millions. By Prof. Radhakamal Mukerjee. (Macmillan & Co., Ltd., London), 1938. Pp. xvi + 267. Price 7*s*. 6*d*. net.

Prof. Mukerjee of the Lucknow University is well known for his many thoughtful works on Indian Economics and Sociology. In his latest work, just published, he has systematically surveyed the relations between agriculture, nutrition and population in India. The book merits the serious attention of all interested in the welfare of the country. It will open everybody's eyes to the rapid growth of population and the serious shortage of food supply, and offers a basis of economic planning suitable for adoption by our administrators under the new regime.

The first two chapters deal with 'Pressure of Population' and 'Population Capacity and Food Supply'. From 1871 to 1931 the population of India increased from 206 millions to 353 millions; in 1935 it is estimated to have reached 377 millions and threatens to number 400 millions before long. The author has calculated the total food supply from all sources and even adopting a low standard of requirement, comes to the conclusion that India has now fallen short of food for 48 millions of her average men, provided that agricultural seasons are normal, and droughts and floods do not occur. The agricultural depression has rendered cereal cultivation unremunerative in many areas in small holdings and the tendency of the exports of food crops to diminish does not meet the situation. On the whole, even taking into account the diminution of exports of agricultural produce, the food available per head for consumption has declined. While no less than 12 per cent of the population are completely unprovided for, a considerable proportion of the peasants and workers show inadequacy or unbalance in their food. The author rightly emphasises that a considerable proportion of disease and inefficiency in India has its primary cause in diet deficiency and poverty. The toll of epidemics and the working of other Malthusian checks is referred to in the third chapter.

Food standards and food values, and nutrition levels in different regions and classes are ably treated in the succeeding chapters. Most of the agricultural castes are vegetarian, and milk and milk products and *dal* are the chief sources of proteins. A considerably lower standard of protein requirement, as compared with Western standards, is considered adequate for India, and the traditional vegetarianism of the people is traced to the pressure of poulation on land. The importance of legumes, like peas, beans and pulses is stressed and the introduction of soya-beans is strongly advocated. The lines of improvement of food crops and dietary, and the extension of industrial crops and rural industrialisation are dealt with in two chapters. India's pace of industrialisation is exceedingly tardy and the extension of industries, large, medium-sized or small, is considered the most important means of relieving the present heavy pressure of population on the soil. The author stresses the important rôle of those industries in particular which are distributed nearer the sources of raw materials and offer facilities to the peasants to obtain remunerative prices for the cultivation of raw materials and industrial crops, which may supplement their subsistence cropping.

Prof. Mukerjee also advocates a diminution of hordes of superflous cattle and the rearing of better breeds. Remedies of population pressure are discussed in the thirteenth chapter, and the two final chapters deal with "New Social Attitudes" and "Dysgenic Trends of Population". Here the learned author dwells on the urgency of primary education and such measures of social reform as inter-caste marriage, widow remarriage and the abolition of dowry and bride-purchase. He strongly advocates limiting the family by using methods of birth control.

The book is a mine of useful information on all the various topics included in the wide survey, and the ripe experience and critical faculty of the author contrive to bring out clearly the right and proper methods of food planning. It should furnish abundant food for reflection to the administrator, the economist, the agriculturist, the industrialist, and the social worker alike. The treatment of the subject is throughout scholarly without being pedantic.

B. L. B.

Where Theosophy and Science Meet. A Stimulus to Modern Thought—A Collective Work. Edited by D. D. Kanga. (The Adyar Library Association, Adyar, Madras), 1938. Part I. Pp. 163. Price Rs. 1–14–0 or 3*s.* 6*d.* or 0·85*c*.

Dedicated to H. P. Blavatsky, the first volume or part of the series described to be the outcome of the combined and co-operative effort of a number of members of the Theosophical Society anxious to share the truth or truths seen and realized by them, is devoted to a study of the advancement of life from 'Macrocosm to Microcosm'. The Publisher's Note explains that the entire series made up of monographs written by specialists in science and theosophy will be published in *four* parts at intervals of two or three months. The work is edited by D. D. Kanga who has retired from the Indian Educational Service, and is intended to serve as a stimulus to modern thought.

The first part now published is entitled "From Macrocosm to Microcosm", the second, "From Atom to Man", the third "From Humanity to Divinity" and the fourth "Some Practical Applications". The contributors, Indian, European and American, notwithstanding their obvious differences due to heredity, nationality, *et hoc*, find themselves in agreement regarding the central thesis that Theosophy as understood and interpreted by the monographists and those from whom they have derived their inspiration, is sufficient to solve many of the complicated problems with which modern mankind finds itself confronted to-day.

In the course of the "Introduction," the Editor points out that the "present world crisis is due to the State-chariot being driven by three uncontrolled horses proceeding with unequal speed···" and that "the key to the situation is the study and practice of Theosophy" (p. 11). In the next contribution, Dr. P. K. Roest admits "theosophical formulations are bound to be quite frequently different from those of science on the same subjects," and Fritz Kunz, in his contribution, defines "our position" as "that of a thorough-going conceptual monism" (p. 27). G. Polak emphasizing the basic unity of Life feels sure that man's mission will be accomplished only when that state is reached in which

"My throbbing shall be the throbbing of the whole universe" (p. 52). A. F. Khudsen records theosophical corroboration of geological calculation of the age of the earth, or geological corroboration of theosophical computation, if you please. G. N. Drinkwater writes in a similar vein on "Archaeology". Marguerite writing on the "Meaning of Symbols", "A Psychological and Philosophical Survey" concludes that the study of symbols "proves that at all times the same essential cosmic truths were taught which form the basis of Theosophy···" (p. 134). Then follows a list of "Scientific Corroborations of Theosophy".

I have summed up at some length the contents of the volume under notice, lest I be accused of having done scant justice to a laudable theme and venture, but, I regret to have to observe that the volume reveals more of partisan enthusiasm, an inordinate desire somehow to find scientific corroboration of theosophical truths rather than any scientific spirit of disciplined investigation. Dr. G. S. Arundale in his *Foreword* has delivered himself of such amusing definitions of Theosophy as must render remarkably remote any chance of a meeting between Science and Theosophy. "Theosophy", he observes, "is the *experience* of the *greatly wise* (italics mine) from time immemorial", and in the next paragraph, he declares, "Thus is Theosophy the eternal mountain of *experienced truth*" (italics mine), "a mountain of Universal Truth", and whatever monists, mystics, metaphysicians and others may say or claim to have realised, an entity *can never be experience and experienced Truth*. Dr. Arundale's definition, or description or whatever it is, stands sentenced to logical demise by its own inherent contradiction. Rhetoric is poor substitute of Reason. Gift of metaphor in the place of metaphysics is gift of stone for bread.

In a journal like *Current Science*, one or two questions should be straightforwardly asked and honestly faced. Modern Science (I use the description collectively) is grounded on quantitative and qualitative methods of exact, precise measurement, experimental control of the phenomena investigated under laboratory discipline, and the explanatory linking of the data collected into laws of universal validity and applicability. Verification under the conditions and discipline of laboratory investigation is the life-breath of modern science. So far as I am aware and so far as the evidence furnished by the book under notice indicates, Theosophy has never attempted a like verification of its data.

Should at all Science and Theosophy meet? I would immediately remove the term "Theosophy" and substitute "Vedanta" or any other similar system of Thought the subject-matter and data of which *ex hypothesi* lie beyond the pale and jurisdiction of experimental verification. The matter may not be allowed to rest here. Who wants the meeting? Is it the scientist or the theosophist? What is the harm cosmic or individual, microcosmic or macrocosmic in Theosophy and Science keeping strictly to their different paths of investigation? Unless indeed these and allied problems are boldly faced and courageously answered there would be little advantage in any artificial unity or *rapprochement* between Science and Theosophy. That is why traditional Eastern wisdom classified the different branches of knowledge according to the nature and characteristics of subject-matter investigated. *Adhyatma Vidya* or philosophy or metaphysics proper, or *Brahma-Vidya* was believed to be a systematic study of certain entities not accessible to the senses *Ati-Indriya*.

Let me lay bare the mental mechanism of those who desire to bring about and arrange for a meeting between Theosophy and Science, and turn on it the search-light of critical attention or examination. Sometimes, even the confirmed atheist, materialist, or the laboratory scientist develops a faint heart, a lily-livered mentality and feels peradventure vague fears of hell-tortures, or sees visions of rosy romance with heavenly houries. Such a scientist may require corroborations from Theosophy or Philosophy.

On the other hand, even a confirmed Theosophist or a philosopher is bound to feel sometimes that he is not standing on the *terra firma* of verified and verifiably or demonstrably certain facts, and that he has been too much above the clouds. Such a theosophist or a philosopher may require corroborations from Science.

I for one am able to see or feel absolutely no need for any meeting between Science and Theosophy. No doubt successful discoveries in the realm of the sciences and their application to the practical concerns of life like industry, means of communication, war-

fare, etc., make it appear as if Science rules. That cannot be helped.

The great religions of the world have all emphasised that the present existence on earth is to be viewed and lived as a preparation for the next, with faith in the grace of God and with realisation of the truth that one's fellowmen are likewise pilgrims proceeding along the Pathway to Reality. *Mind-Control* is the sovereign remedy for practically all the ills that assail civilised nations and communities to-day. *If Theosophy grew scientific, and if Science grew theosophical, neither would do any good to mankind.* Each should pursue its own way and enrich the resources, material and spiritual, of mankind.

R. NAGARAJA SARMA.

British Chemical Industry.*

SIR GILBERT MORGAN and DR. D. D. PRATT have written a most remarkable book. On a screen astonishingly small in relation to the vastness of the subject, they have thrown a moving picture of British chemical industry that rivets attention from cover to cover (dyed with Monastral fast green GS), being historical, modern and vivid. Especially in this country, where an aptitude for chemical industry has been slow to reveal itself, the new treatise will be valued as a foundation for practice and a stimulus to development. In a most attractive literary form, it provides the advanced student with concise but ample information; and should be consulted also by those members of the cultivated public who desire to be cognisant of industrial progress.

The authors have adopted an agreeable arrangement of the chemical arts by grouping them under the naturally occurring raw materials on which they depend. Thus the opening chapter, "Salt", describes alkali manufacture and industrially important chlorine compounds such as bleaching powder and aluminium chloride, while "Sulphur" covers the various forms of sulphuric acid and the related salts of the oxyacids. "Sand, Clay and Limestone" is the chapter-head introducing glass, lime, cement and ceramics, followed by "Industrial Gases" embracing air-liquefaction, the rare gases, synthetic ammonia, nitric acid, carbon dioxide and acetylene. Then follow "Selected Metallurgical Processes" to include nickel, precious metals, sodium, aluminium and magnesium; "Borax and Phosphate" dealing with the manufacture of some new abrasives, phosphorus and superphosphate; "Paints and Pigments" describing the whole range of industrial whites, metal-colours, lakes and monastrals, concluding with sections on the ingredients and manufacture of paints. "Oils, Fats and Waxes" is the caption for vegetable, animal and marine esters, their extraction, refining and hydrogenation, with attention to margarine, soap and glycerine; while "Cellulose" deals with paper and rayon. "Coal" presents the gas, coke and tar industries, low temperature carbonisation and coal-hydrogenation; the remaining chapters comprising petroleum, explosives, dyestuffs with intermediates, plastics with rubber, industrial solvents and fine chemicals, the last-named including anæsthetics, hormones and vitamins.

Along with clarity of exposition, a welcome feature is the skill with which modern practice has been shown to proceed from the more venerable methods. Thus an outstanding impression in the mind of a reader will be the revival, almost a renascence, noticeable in this industry since the War. On an early page the authors replace the old saying that "there was no better barometer to show the state of an industrial nation than the figure representing the consumption of sulphuric acid per head of population," by the more pertinent dictum "there is no finality in chemical industry". Abundant illustrations of this principle are given, among which the following may be mentioned. Until the beginning of the century industrial oxygen was made by Brin's process, now entirely superseded by air-liquefaction and fractionation, leading to scores of millions of cubic feet being used annually for metal-cutting and acetylene-welding, while commercial uses have been found for the by-products, argon, neon, helium, krypton and xenon. The refining

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* *British Chemical Industry; Its Rise and Development.* By Sir Gilbert Thomas Morgan and Dr. David Doig Pratt. (Edward Arnold & Co., London), 1938. Pp. xii + 387; plates 32; figures 79; tables 34. Price 21*s*.

of nickel by the Mond (carbonyl) process, one of the outstanding chemical engineering achievements of recent years, now deals with huge deposits of ore derived from Ontario, yielding concentrates rich in platinum and palladium, with minor quantities of rhodium, ruthenium, iridium and gold. Particularly engaging to Indian readers will be the section on aluminium, not only because, arising from the enterprise of Sir Alfred Chatterton, use of aluminium household vessels is widespread, but also for the much canvassed possibility of manufacturing the metal in this country, which possesses the necessary bauxite. Its high electrical conductivity has lately brought aluminium into rivalry with copper as a current-carrier on a very large scale indeed, and its property of yielding an extensive range of alloys with copper, chromium, manganese, nickel, silicon and zinc has greatly augmented the demand in recent years. Even more dramatic has been the commercial emergence of magnesium, now used increasingly in making light alloys required for aircraft, of which magnalium (Mg : Al = 1 : 9) is an example; within twenty years the price per pound has fallen from 25*s.* to 1*s.* 3*d.*

The history of rayon is a wonderful record of perseverance and ingenuity resulting in a new and beautiful fibre being added to the resources of textile manufacturers. In 1891 the Chardonnet process yielded 30,000 pounds of artificial silk through nitrocellulose, and in the following year Cross and Bevan discovered the cellulose xanthate reaction; although application was greatly delayed by technical difficulties, these were finally overcome by Courtaulds, Ltd., on whose patience and skill the vast rayon industry of the world is founded. The 1,000,000,000 pounds manufactured in 1935 comprised viscose yarn (76%), viscose staple fibre (10%) and cellulose acetate yarn (12%), with minor quantities of cuprammonium and nitro-yarns. This imposing production equalled one-third of the total wool-consumption and ten times that of natural silk; the price per pound had fallen to 2*s.* 6*d.* from 12*s.* 6*d.* in 1925. Incidentally, rayon has presented the dye-chemist with new problems, and has had a share in the recent rapid growth of the lacquer-industry while creating a fresh demand for caustic soda, carbon disulphide and acetic acid.

Among so much material of absorbing interest many readers will turn eagerly to the chapter on dyestuffs and intermediates, and will there find a 30-page review of the old, old story which nobody is better qualified to tell than Sir Gilbert Morgan. Some will remember pleasurefully his Hofmann Memorial Lecture (1936) but the present survey is even more vivid, and has the advantage of crowning the early history with a lucid account of quite recent discoveries. No branch of scientific endeavour stages a richer pageant, or one more dramatic in its interplay of success and failure. There pass before us in rapid succession the pioneers, Mansfield, Perkin, Nicholson, Read Holliday, Dan Dawson, Greville Williams and Ivan Levinstein. Then comes the decline of 1865–79 when the Anglo-Germans, Hofmann, Caro, Martius and O. N. Witt returned to the fatherland, recalling the departure of the Roman legions; while Nicholson, Perkin and Greville Williams retired from the struggle. There follows the fall, with increasing predominance of the Rhine, lasting until the War of 1914–18. Thereafter the renascence, effected by the British Dyestuffs Corporation and Sir James Morton, later fortified by the Dyestuffs Group of Imperial Chemical Industries. Table XXX (p. 293) shows 4,000 tons of British dyestuffs to have been manufactured in 1913 (with no vat-colours), and a 1935 output of 26,000 tons including over 4,000 tons of indigo and other vat-colours. Conspicuous among the latter is Caledon jade green, whose romantic history is here narrated as a preface to the Soledons and Ionamines, to be followed by the Duranols and Carbolans, dispersed dyes for acetate rayon.

It might have been expected that the three succeeding chapters would seem an anticlimax, but this is not so, for they deal respectively with plastics and rubber, industrial solvents, and fine chemicals, all of which branches offer surprising novelties of industrial practice. The first describes resins of the bakelite group, then plastics made by combining formaldehyde with casein and with urea (for non-crease Tootal fabrics), the glyptal resins (paralacs) arising from polybasic acids and polyhydric alcohols, and finally the polymerisation resins, exemplified by perspex, the organic glass obtained from methyl methylacrylate. In

1923 the British output of phenol formaldehyde resin approached 500 tons, rising to 15,000 tons in 1936. This remarkable growth has greatly stimulated the manufacture of organic solvents, these being required for applying the resins in the form of lacquer. Not only has the range of solvents been vastly widened, but the quantity in which some are produced has been greatly increased, the most spectacular advance being the synthetic manufacture of methanol. Formerly a by-product of wood distillation, methyl alcohol is now made by catalysis of mixed hydrogen and carbon monoxide, the world-production exceeding 200,000 tons annually.

The very high standard of this work is fully maintained in the final chapter dealing with fine chemicals, among which are mentioned the many new organic reagents for metals depending on the formation of co-ordination compounds; and the spot-tests for phosphorus, tryptophan and the ergot alkaloids. Disinfectants (including the lime-lit prontosil), antiseptics (with dettol), fungicides and insecticides receive due notice, while the pharmaceutical products include anæsthetics, soporifics, antipyretics, arsenicals, sucramine (the ammonium derivative of saccharin, which it excels in sweetness), hormones and vitamins. The section on insulin outlines the manufacture, and relates that the price of this hormone has fallen from 25*s.* to 1*s.* per 100 units of a purity-degree so high that one part will remove 40,000 parts of glucose from the blood stream. Under vitamins will be found a description of the four whose chemical constitution has been elucidated, three of which are now manufactured and sold as adjuvants; here is a noteworthy case of highly refined investigations, conducted in more than one branch of science, being rapidly brought to the service of mankind by enterprising industrialists.

It will now have become evident that this latest work of Sir Gilbert Morgan with Dr. Pratt has quite exceptional interest and value. Table XXXIII (p. 367) shows that the British chemical industry employs over 660,000 persons, and exceeds £400,000,000 in gross output value; but the vital doctrine herein conveyed is the necessity of scientific vigilance and ceaseless research in maintaining this huge superstructure. From that standpoint the book should be read not only by every advanced student and teacher of chemistry, but by all those of non-scientific habit who aspire to guiding public opinion, or to taking part in the government of this country. Here, as in England, there is a tendency not merely to ignore science, but to mistrust it; and even worse, to saddle it with the horrors of modern warfare, disregardful of the fact that these horrors are perpetrated by agents not having the most elementary claim to be classed as men of science. So distorted is the public view of this matter, even among people of cultivated intelligence, that an eminent ecclesiastic recently called for a halt in scientific discovery and invention. In the same confusion of mind an English writer of some (literary) reputation smugly announced, with incredible deficiency of humour, that he had sold his holding (£80) in Imperial Chemical Industries, Ltd., on finding that they manufactured explosives. He did not realise that this is merely one of their countless interests, and that in peacetime these products are manufactured for peaceful purposes alone. It would be more reasonable to refrain from investing in Funding Loan on the ground that the British Government manufactures its explosives solely for war, or preparation for war: or from buying shares in a company making weed-killer, because this is known to have been used for removing inconvenient wives.

If such blind leaders of the blind took the trouble to inform themselves by reading the treatise of Sir Gilbert and his colleague, they would be compelled to recognise that only a minute fraction of the chemical industry is concerned with war-material, and that even this would remain in the harmless category of scientific curiosities or engineering requirements but for the hateful action of non-scientific peace-breakers.

M. O. FORSTER.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(*University Librarian, Madras*)

Malebranche, Nicolas (1638–1715)

NICOLAS MALEBRANCHE, a famous French metaphysician and mathematician, was born at Paris August 6, 1638. He was the youngest of ten children. His father was secretary to the king. Being sickly he could not attend a public school. After private tuition and a course in theology at the Sorbonne, he took orders in his twenty-third year. His superiors directed him to study church history. But failing to retain facts in his memory, he could not make much progress. His genius remained undeveloped till his twenty-sixth year, when Des Cartes' posthumous *Traite de l'homme* fell into his hands and opened a new world to him. He then abandoned ecclesiastical history and rabbinical lore and plunged with ardour into metaphysical and scientific speculations.

His Contributions to Philosophy

The first and greatest work of Malebranche was the *Racherche de la verite* (1674). It went through many editions and appeared also in Latin and English translations. He wrote several other works which were all collected together in eleven volumes in 1712.

His Contributions to Mathematics

His first piece of research in mathematics related to an explanation of the apparent increase in the diameter of the moon while at the horizon. The *Elements de mathematiques* produced by his student Marquis de Preslet is attributed to Malebranche as the real author by Wallis. Similarly his hand is seen in the *Analyse des infiniment petits*, a work of Marquis da L'Hospital, another of his students. Euler rescued and published several of his results in arithmetic. All his principal mathematical contributions were collected together in print in 1880 by Charles Henry in a work entitled *Recherches sur les manuscripts de Fermat suivies de fragments inedits de Bachet et de Malebranche*.

His Fame and His Outlook

Malebranche was an honorary member of the Academie des Sciences of Paris. In the height of his fame he was overwhelmed with correspondence and visitors, the list including kings and princes as well as many philosophers from other countries. Liebnitz was a frequent visitor. Malebranche was at bottom a solitary thinker rather than one learned in the opinions of others. From the time his genius was stimulated by Des Cartes he sought to enlighten his mind by meditation, rather than to store his memory with the contents of books. An insect, we are told pleased him more than all the books of Greece and Rome. He despised erudition and the kind of philosophy which consists in a collection of the dogmas of various philosophers, since a man may be learned in the history of opinions of others or at least in the verbal expression of these opinions, without himself having learnt to reflect at all. Indifferent to books, he used to meditate in the dark, with the windows shut.

His Dramatic End

Malebranche's end was one of the most dramatic incidents in the history of thought. Berkeley, who had just then published his famous book on immaterialism, sought an interview. He found the aged Father in his cell, cooking a medicine for an inflammation of his lungs. A debate ensued on Berkeley's system. In the heat of dispute, Malebranche raised his voice so high and gave way so freely to the meterial impetuosity of a man of genius and a Frenchman, that he brought on a voilent increase of his disorder which carried him off a few days later, October 13, 1715.

Eimmart, Georg Christoph (1638–1705)

GEORG CHRISTOPH EIMMART, a German Astronomer, was born of a painter at Regensburg, August 22, 1638. Having learnt the art of his father, he studied mathematics at Jena, where he cultivated a passion for astronomy. He settled at Nuremberg and made his astronomical observations for several years, along lines laid down by Regiomontanus. Eimmart was in charge of the Nuremberg Observatory from 1668 till his death.

His Contributions

Eimmart contributed several papers, which were all mostly published in the learned periodicals of Leipzig. One paper entitled *Observation of the eclipse* (of the moon)

November 30th last, made at Nuremberg appeared in V. 16 (1696) of the *Philosophical transactions* of the Royal Society. His contributions occupy 50 folio volumes.

Collaboration with Daughter

Eimmart had the rare good fortune of having an intimate collaborator in his own daughter Maria-Clara Eimmart (1676–1707). Besides helping her father in the compilation of several astronomical tables, Maria-Clara helped him in making 300 drawings of the phases of the moon as seen through the telescope. A further interesting fact is that her husband Henri Muller succeeded Eimmart as the Director of the Observatory at Nuremberg.

Eimmart died at Nuremberg January 5, 1705.

Geddes, James (1763–1838)

JAMES GEDDES, an American Canal Engineer, was born near Carlisle, Pa, July 22, 1763. Till his fortieth year, there was no indication either of engineering interests or engineering talents in him. In 1794, he removed to Syracuse and became one of the pioneers in salt industry. Then he studied law. In 1800 he was made a Justice of the Peace and in 1809 he was appointed Judge of the County Court. He was elected to the Assembly in 1804 and again in 1822. He also served in the Congress from 1813–15.

Stimulation of Engineering Interests

In 1804, when he was a member of the Assembly, the Surveyor-General of New York broached to him the possibility of constructing a canal from the Great Lakes to the Hudson River. This kindled his imagination. He personally investigated the subject and started a vehement propaganda for the undertaking. Moreover, though he had no technical training whatever, he himself ran the first survey in 1808. Then he made similar surveys for two other canals including the Erie canal. After the war of 1812, Geddes was engaged by the Canal Commissioners as one of the four principal engineers. His services were requisitioned throughout the Eastern States and by the Federal Government in exploring and designing several canals.

He was thus in active exploration work till his death in August 19, 1838.

Warington, Robert (1838–1907)

ROBERT WARINGTON, a British agricultural chemist, was born in Spitafields August 22, 1838. He is said to have owed his chemical proclivities to his father, Robert Warington who was one of the influential founders of (British) Chemical Society (1841). Young Robert learned his chemistry at his father's laboratory at the Apothecaries' Hall, where his father was obliged to reside as the Chemical Operator of the Society. Life in the heart of London with no exercise undermined his health.

His Career

Warington was at first an unpaid assistant of Mr. Lawes at the Rothamstead Laboratory (1859) and learned ash analysis. From 1860 to 1862, he worked at South Kensingston as research assistant under Dr. Franklend. Another breakdown in health necessitated a change to country life. Accordingly, Warington spent the next five years as a teacher in the Royal Agricultural College at Cirencister. From 1867–76 he was chemist to Lawes' manure factories at Millwall. Then he turned to Rothamstead once again for a short while and finally settled at Harpenden.

His Contributions

Warington was a profuse writer. 63 papers (including 5 joint ones) were published by him between 1863 and 1900. The first paper bore the title *On the Quantitative determination of the phosphoric acid, by salts of magnesia* and appeared in the *Journal* of the Chemical Society. The last paper, which appeared in the *Proceedings* of the same Society was on *Recent researches in nitrification.* One of the most useful of his writings is a little volume entitled the *Chemistry of the farm* (1881). It is a most widely read book on the subject. It reached its 19th edition during his life-time. It was translated into several foreign languages.

Nitrification

Speaking generally, Warington's work consisted largely of examining and perfecting methods of analysis for use in agricultural chemistry. Most of the methods of analysis elaborated by him have been accepted as standard methods. But his fame rests mostly in his contributions to nitrification. This subject engaged him from 1877 to 1891. His first paper on the subject was entitled *On Nitrification,* and was published (1877) in

Vol. 33 of the *Journal* of the Chemical Society and in Vol. 94 of the *Annales de Chemie*. Warington confirmed the biological nature of nitrification not only in soil but also in ammoniacal solutions inoculated with soil. He showed also that the nitrous organisms were entirely confined to the first nine inches of ordinary soil (1887). He further showed that the nitrification of organic nitrogenous substances (urine, milk) has to be preceded first by their transformation into ammonia. Warington was one of the first to demonstrate that an approximate increase of 350 pounds of nitrogen per acre may be obtained as a result of the growth of inoculated legumes.

In 1906, Warington's health gave way. He had to undergo a serious operation. He never regained his health after this and he passed away, March 20, 1907.

ASTRONOMICAL NOTES.

Planets during September 1938.—Mercury will be a morning star during the month and will be visible low down near the eastern horizon for a short while before sunrise. There will be two conjunctions of the planet with Mars, one on September 4 and the other, a very close one, on September 16. Venus will continue to be a very conspicuous object in the western sky ; it reaches greatest eastern elongation ($46°\cdot3$) on September 11 and can be seen in our latitudes for nearly three hours after sunset. Mars is slowly moving away from the sun but is still not favourably placed for observation. On September 5, the planet will closely approach the first magnitude star Regulus (α Leonis).

Jupiter will be on the meridian at about 10 p.m. and will be in a convenient position for observation in the early part of the night. So also will be Saturn, which will be a fairly bright object rising about an hour and a half after sunset. It will continue its slow retrograde motion in the constellation Pisces. Uranus is likewise moving slowly in a retrograde direction in the constellation Aries. A conjunction with the Moon takes place on September 14, which will afford an opportunity to observers with simple optical aid to locate the planet. A lunar occultation of some interest that can be seen in this country is that of β' Scorpii (magnitude $2\cdot9$) which will occur at about 8 p.m. on the night of September 28.

The Milky Way.—There are a number of interesting regions of the galaxy which can be conveniently observed during the month, immediately after sunset. The great star clouds in Sagittarius, the regions in Aquila and Cygnus which are extraordinarily rich in faint stars, are some of the parts of the Milky Way which merit special attention. Side by side, there are the dark holes and rifts in Ophiuchus and other places, regions apparently devoid of stars, which will repay a careful study. In these regions are found extensive dark clouds which obscure the light of stars situated beyond. These dark nebulæ are comparatively near the sun, the distances varying from a hundred to a thousand persecs.

Zeta Aurigæ.—This is a well-known eclipsing binary system in which the two components eclipse each other in a period of 973 days. During the two recent eclipses, photometric and spectroscopic observations have been obtained in considerable detail by a number of observers. Some interesting facts have been deduced from a preliminary discussion of the results, which indicate that the two components are not of equal dimensions. The diameter of the larger star is about twenty times that of the smaller, which, in turn, is ten times that of the Sun. The larger star is of Spectral type K and has about fifteen times the Sun's mass while the smaller, of type B has eight times the mass of the sun.

T. P. B.

RESEARCH ITEMS.

Binary Quadratic Forms with a Single Class-determinant in each Class.—A. Hall (*Math. Zeit.*, 44 Bd., pp. 85–91) has given certain conditions that the discriminant of a quadratic field (discriminant negative) has to satisfy in order that there is exactly one class of forms in each genus. After Heilbronn proved that the number of classes of quadratic forms with discriminant $\sqrt{-D}$ tends to ∞ with D. S. Chowla showed that the number of classes of quadratic forms in each genus also tends to ∞ with D. Gauss had conjectured that there were only 65 numbers for which the number of classes in each genera is unity. Now Hall has given a number of conditions that D satisfies, in order that it is unity, so that he has contributed a good deal towards the settling of Gauss's conjecture. Some of the theorems he proves are given below:

(1) If $D = 7, 15, 12,$ or $0 \pmod{16}$,
$D \neq 7, 15, 12, 28$ or 60,
$D \neq 16n$ or $64n$, $n = 1, 3, 7, 15$
$D \neq 32 \pmod{64}$, the number of classes in any genera is always greater than unity.

(2) If p^2/D, p, a prime number the same result is true except for a finite number of values of D.

K. V. I.

Remarks on a Sequence.—An interesting property of the sequence $[n\alpha]$ where $[x]$ denotes the highest integer contained in x has recently been noticed by Sprague (*Math. Zeit.*, pp. 20–22). It is obvious that the sequence $[n\alpha]$ contains the sequence $[n \,.\, (r\alpha)]$ where r is any integer. Now apart from this trivial case does the sequence $[n\alpha]$ contain another sequence $[n\beta]$ which is not trivial in the previously explained sense? The author has shown by easy calculations [α and β are of course irrational] that $\alpha > 2$ is the criterion for the above property. If α is > 2 and l any integer $> \frac{1}{\alpha - 1}$, then the sequence $\left[n \cdot \frac{\alpha}{l + 1 - l\alpha}\right]$ is a subsequence of the sequence $[n\alpha]$. In terms of irrational numbers the result becomes the following:—If $\frac{\alpha}{\beta}$ is irrational $\alpha > \beta > 0$, then between any multiple of α and any multiple of β there does lie some multiple of $\frac{\alpha \cdot \beta}{\alpha + \beta}$; if the distance between the multiples considered be $< \beta$, then the interval does not contain any multiple of $\frac{\alpha \cdot \beta}{\alpha - \beta}$.

K. V. I.

Sol-Gel Transformations: Sols, Jellies and Curds of Sodium Oleate.—An exceedingly interesting paper on the nature of jellies and curds of sodium oleate has been published by E. Heymann (*Trans. Faraday Soc.*, 1938, 34, 689). Sodium oleate gel is a unique system in that it can exist in two forms, the clear jelly and the opaque curd. By a study of the electric conductivity of these forms Laing and McBain have previously shown that the sol and jelly of sodium oleate which are similar, differ from the curd in structure. Further elucidation of the nature of this difference has been made by the author by a study of the densities of the system sodium oleate-water in its three states and the volume change during the sol-clear jelly-curd transformation.

20·5 per cent. solutions when cooled to 14.8° C. showed the sol-jelly transition, after several hours, followed by the clear jelly-curd transformation which was complete after several days (sometimes 2 to 3 months). The time after the first appearance of the curd nuclei till the curd formation was complete increased with increasing purity of the soap, obviously indicating that small amounts of impurities may act as centres of crystallisation.

There was no change in volume, when the clear jelly was formed from the sol. As soon as the curd formation began the volume decreased and a strong volume contraction was observed with progressive curd formation. The latter observation is significant in view of the fact that in other sol-gel transformations, volume increase owing to decrease in hydration is usually noticed.

By the measurement of densities, it was found that the observed specific volume of the sodium oleate solution was equal to that calculated from its components thereby showing the absence of electrostriction (volume contraction). The salts of lower fatty acids however (*e.g.*, sodium acetate) show very significantly electrostriction. This is obviously due to hydration as a consequence of dissociation and of the dipole moment of the COONa group. The action of this group cannot however differ much with salts of higher fatty acids. Therefore the absence of electrostriction observed is only apparent and attributed to the counteracting process which takes place simultaneously in sodium oleate solution.

The volume change during the process of dissolution of sodium oleate directly in water has been investigated. Sodium oleate swells in water giving an opaque curd which is quickly transformed into a clear jelly. Numerous experiments on soap + water $\rightarrow$ curd $\rightarrow$ clear jelly transformations show a decrease of volume in the first stage and an increase in the latter.

This significant observation on the volume decrease in clear jelly-curd transformation or the increase in the reverse process, which cannot be explained on the basis of hydration, is attributed to a change in the micellar arrangement. The liquid micelles in the sol and the clear jelly being structureless and non-crystalline are more loosely built than the crystalline particles of the curd. Therefore there is close packing of the micelles in the latter and sparse disorderly arrangement in the former. This interesting picture of the arrangement of the micelles in the soap curds and jelly explains satisfactorily the anomalous volume change associated with the clear jelly-curd transformation.

K. S. Rao.

Seeds and Germination.—As a result of studies initiated in the Boyce Thompson Institute for Plant Research, Willlam Crocker has defined several classes of seeds in respect of the causes of their delay in germination and has worked out methods for shortening or completely overcoming the delay (*Professional Paper*, April 1936, **1**, No. 29). He finds that the hard coated seeds protect the embryos against the action of moisture and oxygen of the air, and are capable of maintaining their vitality in herbaria and seed cupboards for a century and a half. Filing the hard coat or softening it with hot water or sulphuric acid treatment and then abrading the outer coats are the methods suggested for accelerating germination. Seeds which are impervious to the oxygen supply of the embryos or, are sensitive to light, germinate when planted with little or no soil over them. In the case of seeds of the temperate zone the low temperature stratification ranging from 30° F. to 50 or 55° as a means of after-ripening them for germination, has been found to induce chemical and enzyme changes, necessary to induce the embryos to break the coats. Miss Flemion of this Institute has developed a method by which the viability of even the slowest germinating seeds can be determined. The process consists in removing the embryos from the seed coats and placing on moist filter-paper in Petri-dishes. The live embryos enlarge and in light become green. This method may prove of great value to the seed industry, especially for slow germinating seeds.

A Beetle Pest of Sugarcane.—An account of what threatens to be a serious insect pest of sugarcane in Burma on account of which in extreme cases the cultivation itself has had to be given up in some areas and of a study of various methods of combating the pest is given by C. G. Ghosh (*Ind. J. of Agric. Sci.*, **8**, Part VI). The pest is the black Dynastine beetle *Alissonotum impressicolle* Arr. of which both the larval and the adult forms are responsible for the damage; the larvæ are more serious to ratoon canes than the adults and are capable of killing off entire fields by gnawing away the roots in the course of a few months. The attack is serious only where the ratooning of cane is practised; if the cane crop should be grown only as an annual crop and if it should, in addition, be followed by a non-cereal crop, the beetle can be wholly overlooked. In Burma however, the practice is said to be to ratoon the cane continuously; three ratoons are common and even a fourth and fifth are mentioned. The conditions are, therefore, ideal for the increase of the pest. In addition to the life-history of the pest most of the familiar methods of control were tried, and studied. None of these methods was found to be satisfactory. Among the varieties tried, *viz.*, D. 74, EK 2D, B.H. 10–12, Striped Mauritius, Gilman, POJ 2727 and 2878, F 74, S Mau, Pyinmana Red and Yellow, and Co. 210, 213, 214 and 281, none was found immune; the Co. 213 was however more resistant than the thick canes. Birds, insect and fungal enemies exercised little check. Traps and baits, fumigants like carbon disulphide, potassium cyanide, paradichlorobenzene and several proprietory preparations like Seekay, R.V. 4, etc., were also ineffective. Among cultivation methods, fallowing was the only one which appeared promising, and this and a restriction of the practice of ratooning are recommended for keeping down the pest. Attention is also drawn to experience elsewhere, *viz.*, to the success with the predatory giant toad, *Bufa marinus*, introduced from Barbados to control the allied pest May beetle in Puerto Rico and in the Mauritius, Hawaii and the Philippines; and a trial of this biological method of control by means of the toad enemy is recommended as an important control measure. A. K. Y.

The Lodging of Cereal Grains.—Yet another contribution to the numerous studies on the subject of the lodging of cereal grains is one on the relation of certain plant characters to strength of straw and lodging in winter wheat by I. M. Atkins (*Jour. of Agric. Res.*, **56**, No. 2). The characters studied were breaking strength of straw, height of plant, length of the lower internodes, date of maturity, weight of grain per 100 heads, weight per 100 culms, diameter of culms at base, and stand. The studies relate to a four-year period from 1931 to 1934; the number of varieties varied from 18 in 1931 to 129 in 1934; the studies were made at the Texas-Sub-station, No. 6, Denton, U.S.A., but use was also made of data relating to the same varieties which were grown at other experiment stations. There was considerable variation in the amount of lodging in the different years due apparently to the seasons but taken in conjunction with results on the other experiment stations, the author considers the data sufficiently satisfactory for drawing conclusions. It is shown that lodging is dependent on a number of factors that vary greatly from year to year making it difficult to find any one index that may be considered reliable. Relative breaking strength of straw is shown to be fairly constant from year to year and the relation of this factor to lodging tendency appears to be high enough to justify its use for evaluating new varieties in respect to lodging. A more satisfactory character for such use however is found to be the weight per unit length of culm taken near the base of the plants; the correlation in this case was much higher between lodging and breaking strength of straw. It is suggested that this character may therefore be used as an index of lodging in preference to the breaking strength of straw as it has the additional advantage of easier and quicker measurement and requires no special apparatus. The weight per unit length of culm taken by the author is the weight of a 10 cm. section including the one node between the first upright internode above the crown of the plant and the one immediately above. A. K. Y.

Reaction Kinetics.*

DURING the last twenty years there has been a tremendous progress made in our knowledge of the structure of molecules and a number of refined mathematical methods of analysing these structures by the application of quantum mechanics have been developed. Parallel with the growth of these knowledges, attempts have been made to apply them to an elucidation of the mechanism of reactions between different molecules, and to a study of the problems of chemical reactions in general. There have been however, also keen studies of the mechanisms of reactions on the purely classical considerations of kinetic theories of collision between molecules and the activation energies as calculated from the Arrhenius equation applied to the temperature coefficient of the velocity of reactions. A fair degree of success has been achieved by either of these methods to account for the observed velocities of reactions, but as far as quantitative results go, the accuracy of the two methods is of about the same order, and must at the present time be admitted not to be very high. Indeed, we have virtually arrived at an impasse, and it was mainly in order to " clarify certain aspects of the reaction velocity problem, and further, to review such facts, which either seemed to bear most directly on these aspects, or to represent a body of knowledge suggestive of further developments " that the Faraday Society organised its Sixty-Seventh General Discussion at Manchester during the September of 1937, under the Presidentship of Prof. M. W. Travers, F.R.S. The report of the papers contributed and discussions thereon[1] provides a wealth of information and some very suggestive thoughts on this very engrossing topic of Reaction Kinetics. The twenty-one contributions made in all by the leading workers in the field, are grouped into 3 main sections: Part I—General: On the Theoretical Methods of Treating Activation Energy and Reaction Velocity; Part II—Some Experimental Evidence bearing on the discussions of Part I; Part III—Proton Transfer Reactions and H^+ Reactions.

The basic idea of exploring the mechanism of chemical reactions by plotting the relevant energy surfaces explains in many cases why activation energy is far less than the energy of the disrupted link or links. By making reasonable numerical assumptions regarding magnitudes entering into calculation one can deduce in certain cases the actual experimental values. Following Eyring, the general theory of activation energy calculation can be expressed as follows. A chemical reaction always involves a change in the equilibrium distance between atoms. If N atoms came together in a non-linear configuration to form the activated complex, then three of the 3 N degrees of freedom can be associated with translation of the centre of gravity of the activated complex, and except for an interaction term which is frequently small, three other co-ordinates can be associated with rotation of the system about its centre of gravity. This leaves 3N—6 internal co-ordinates whose specification, together with the electronic state of the system, fixes its potential energy. The potential energy can then be plotted normal to the configurational co-ordinates in a $3n-5$ dimensional space. The resulting surface will show low valleys or basins which correspond to chemical compounds separated by mountain ranges. Through these ranges there are passes and these configurations are the activated complexes. The mathematical formulation and evaluation of the resulting expressions are none too easy. In the first paper of the Symposium, H. Eyring (Princeton) has given a greatly simplified technique of calculating the activation energies of a system of four atoms. From these energy surfaces the next step is to solve the problem of the rate of elementary or unit reactions, one or more of which go to make up a complete reaction. The treatment of this step will differ with the kind of reaction, according to whether there is a change only in chemical constitution, or in the electronic quantum state of the colliding particles as well. Both statistical and thermodynamic methods have been employed to this end. E. Wigner (p. 29) gives a resume of the statistical methods with special emphasis on the basic assumptions involved. The underlying idea in the theory is to calculate the reaction velocity by multiplying the density of points in the transition state by the average velocity of motion in the splitting bond. It must be made clear that the transition state defined here is in no way similar to the Arrhenius conception of an activated complex. The transition state is a configuration of atoms which resists deformation, *i.e.*, the potential energy increases with deformation, in all directions except along the co-ordinate of the direction path. In other words, it forms a saddle region in phase space, with a maximum in the direction of the reaction path only, but it is a minimum in all the other directions. It is in crossing this layer that a reaction takes place. The thermodynamic methods of considering the transition state as in equilibrium with the reactants, have been developed in the several publications of Eyring, Evans, and Polanyi. In two papers on p. 41 and p. 49 of the present volume, specific aspects of this theory are considered by Eyring and by Evans.

In actual practice, the generalised formula for n-molecular processes are not needed, as most measurable processes are of an order not exceeding two, with possibly just some trimolecular processes. Hence, the simple collision theories developed on kinetic considerations have been found to be quite adequate to account for or explain the observed velocities in most cases. According to this theory, reaction takes place provided (a) the relative kinetic energy in the direction of the line between the two centres of masses exceeds a certain critical value E, and

* Faraday Society Symposium.

[1] *Trans. Farad. Soc.*, 1938, **34**, 1-265, price 12*d*.

(b) the two molecules on meeting are suitably oriented relative to each other. The rate is, therefore, written in the form $P.Z.e^{-E/RT}$, where Z is the actual number of encounters between the molecules concerned, and P is the probability that other conditions beyond mere propinquity must be fulfilled. The recent variations in the collision theories and their applications to reactions and ionisations in solution have been given in the papers by E. A. Guggenheim and J. Weiss (p. 57), R. H. Fowler and N. B. Slater (p. 81), E. A. Moelwyn-Hughes (p. 91) and C. N. Hinshelwood (p. 105). In the interesting discussions that followed these papers among the protagonists of the several theories, it was in general agreed that while the new thoeries still suffered from quantitative inadequacies, they possessed very valuable qualitative and conceptual accomplishments. The newer theories also show clearly the sharp dependence of the reaction velocity on both the activated and the initial states, while this dependence is made clear only in the new derivations of the collision theory.

In the second part of the Symposium are reported the results of a number of very varied experimental studies of several reactions both in the gaseous and in condensed phases. Some of these results are helpful in indicating possible further developments of the theories, while others provide tests of the existing ones. Such experimental facts and more of precise data are particularly needed to foster the new theories of chemical kinetics. In the two papers by Wasserman (p. 128) and C. N. Hinshelwood (p. 138), references are made to a large number of data on the values of E and A in the Arrhenius equation $K = A.e^{-E/RT} = P.Z.e^{-E/RT}$ and the separate variations in these factors with changes in the nature of the solvent, reactants, etc. Thus values of E have been measured ranging from 0 up to nearly 100,000 cal., while A has been found to vary over a range of about 12 powers of ten. There is frequently a correlation between the large values of E, and the large values of log A. M. W. Perrin (p. 144) describes the important influences of high hydrostatic pressures on the kinetics of reactions in dilute solution, particularly when large and complex organic molecules are involved. Attempts have also been made frequently to experimentally resolve the value of E the activation energy into separate contributions due to the known physical and chemical properties of the reactants. Thus L. P. Hammet (p. 156) correlates the changes caused by substituent groups in the energy of activation and in the free energy of ionisation, while H. B. Watson (p. 165), traces the relationship between the energies of activation and the dipole moments of the appropriate substituted benzenes. This latter relation indicates that a substantial part of E is provided by the Coloumbic energy of a pair of dipoles, or ion-dipole. The three remaining papers in this section deal with the allied problems of mechanism of substitution reactions, and tautomerism. A primary dissociation of bonds, as a bimolecular process, is often regarded as an essential phase of reaction involving the migration of atoms or groups. A second interpretation often advanced postulates addition as an essential condition for the expulsion of the group replaced, the mechanism being treated sometimes as a termolecular process with a synchronous addition and dissociation. Most of the prototropic tautomerisms involving the " ionisation " of C–H bonds have been decided as involving consecutive bimolecular processes, but the trimolecular mechanism suggested by Lowry appears also to have a certain range of validity. E. D. Hughes (p. 202) has considered the special case of mechanism of substitution in relation to the general problem of Walden inversion.

In the third and last section, four papers are grouped dealing with proton transfer reactions and their bearing on the general problem of reaction kinetics. The phenomena of the general acid and base catalysis was first found and explained by Brönstead and his collaborators. The volocity of these catalised reactions must be determined by a proton transfer mechanism, the substrate molecule by receiving or giving off a proton getting into an unstable state which leads to the reaction examined. Of fundamental importance in this connection is the relation between the catalytic activity and the dissociation constant of the acid or base, given by Brönstead's equation, $K_c = G.K_1^x$, where K_c is the catalytic constant, K_1 the dissociation constant of the acid or base, and G and x are constants for a given substrate at a given temperature, x being less than unity. This relation holds very well for a number of reactions, but has not yet been given a satisfactory theoretical basis. A great deal of attention has also been directed to determine the rate determining steps in these proton transfer mechanisms, the last paper by K. F. Bonhoeffer (p. 252) being devoted to the investigations on the Deuteron transfer in solutions in order to obtain information on the velocity of transfer of hydrogen ions.

This number of the Faraday Society *Transactions* forms a really important monograph on the subject of Reaction Kinetics, a subject, which should ultimately lead to that goal, envisaged by Eyring, whereat "every problem of chemistry can be answered from direct calculation by a sufficiently skilful mathematician."

M. A. Govinda Rau.

SCIENCE NOTES.

Poisonous Gases in Industry.—The Department of Scientific and Industrial Research has issued the second of a series of leaflets describing standard methods for the detection of toxic gases in industry. The present leaflet (published by H. M. Stationery Office, 5/6*d.* net) deals with hydrogen cyanide.

Hydrogen cyanide is manufactured mainly for use in the fumigation of ships and buildings. It is also used to a small extent industrially as a reagent. Further, it is encountered in concentrations which may be dangerous in certain industrial processes—in blast furnace plants, dyestuffs works, gas works and coke ovens and in the industries of gold mining and gilding.

The leaflet points out that a slight symptom of poisoning will be noticed after several hours with a concentration of one part by volume in 50,000 while a concentration of one part in 500 will be fatal. It goes on to say "in addition to the danger of the inhalation of hydrogen cyanide vapour there is a further danger, even to a man equipped with an efficient respirator or other form of breathing apparatus. This danger is the absorption, of hydrogen cyanide through the skin, which is still greater if the skin is wet with sweat, owing to the ready solubility of hydrogen cyanide in water. The faint almond-like smell is easily missed and is quite unsuitable as a method of detection."

The method of test adopted consists of drawing a sample of the suspected atmosphere by means of a hand exhausting pump through a piece of specially-prepared test paper. Full instructions for preparing the test paper and for carrying out the test are given in the leaflet. The various reagents which will react to hydrogen cyanide are reviewed and those recommended are congo-red-silver nitrate and benzidine-copper-acetate which are capable of detecting concentrations down to one part in 100,000. Test papers treated with these reagents will show characteristic stains, specimens of which are included with the leaflet. Both reactions have been made quantitative and have been developed as standard tests for hydrogen cyanide in industry.

* * *

The Story of Vitamin B_1.—A remarkably interesting brochure dealing with the present status of our knowledge on Vitamin B_1 has recently been issued by Messrs. Merck & Co., Manufacturing Chemists, Rahway, N.J. The story of the Vitamin is told in 7 chapters covering 55 pages. The observations of Takaki which led him to the conclusion that beriberi is of dietary origin, the work of Eijkman on the causation and cure of beriberi by employing experimental animals, the demonstration of the multiple nature of the B Vitamin by Goldberger and others, the isolation of the Vitamin B_1 in crystalline form from natural sources by Jansen and Donath, and finally its synthesis by William and Kline, are all briefly dealt with in the first chapter.* The next 40 pages are devoted to a description of the properties, methods of assay, physiological rôle, distribution in foodstuffs, clinical manifestations of Vitamin B_1 deficiency and its therapy and the rôle of Vitamin B_1 in animal nutrition. The characteristic feature of the pamphlet is that the information is precise and up-to-date and is furnished in a direct and eminently readable manner which will appeal both to the research worker and the cultivated lay reader. It is a unique publication which will be of immense value in spreading the knowledge of the chemistry and physiology of the antineuritic vitamin in a manner not fulfilled by scientific journals.

The credit for bringing together all the available information regarding the vitamin goes to Dr. C. B. Addinall. The brochure is a very good example of American commercial promotional literature.

* * *

Sugar Industry in India, 1936–37.—Mr. R. C. Srivastava's review published as a supplement to the *Indian Trade Journal* (July 21, 1938) comprises all the statistics, (with the exception of those relating to imports, exports and their value), for the period "November-October". Unusually large crops were obtained in this year from a total planted area of 4·573 million acres which was more than the acreage of the previous year by 10·7 per cent. The total yield of cane was 67,322,000 tons—11 per cent. increase over 1935–36. Consistent with the previous years, 1936–37 also showed an increased adoption of improved varieties of cane.

During 1936–37, 140 factories were in operation out of a total of 150 which had been erected, as against 137 which operated in 1935–36. The total production of sugar direct from cane was 1,128,900 tons exceeding for the first time one million tons, the corresponding figure for the previous year being only 932,100 tons. The all-India recovery for 1936–37 was 9·50, which again showed an improvement over the previous year which had a recovery of only 9·29. There was a decline of 20 per cent. in the sugar produced by the indigenous methods which amounted to 100,000 tons.

Total sugar consumed which is estimated at 12 lakhs of tons for 1936–37 is found to be very near the total produced. Imports of foreign sugar fell very sharply from about Rs. 191 lakhs in 1935–36 to about Rs. 24 lakhs in 1936–37. Imports from Java were also reduced by 90 per cent. of the imports in the previous year while the imports from the United Kingdom practically disappeared.

About Rs. 95·2 lakhs of sugar machinery was imported during 1936–37 of which nearly Rs. 68·5 lakhs were spent on British machinery. The total imports in the previous year were Rs. 65·7 lakhs.

The production of "gur" during 1936–37 has also been on the increase and is estimated at 4,481,000 tons as against 4,101,000 tons in the previous year.

* For a critical account of the B-Vitamins see., *Curr. Sci.*, 1936, **5**, 207; 1937, **5**, 577; 1937, **6**, 490.

On the 28th February 1938 the Government of India enhanced the excise duty on sugar produced in the British Indian Factories, from annas 10 per cwt. of Khandasari sugar to Re. 1 per cwt. and from Re. 1–4–0 per cwt. of vacuum pan sugar to Rs. 2–0–0 per cwt. The import duty on foreign sugar was raised from Rs. 9–1–0 per cwt. to Rs. 9–5–0 per cwt. The gross excise duty realised on sugar during the year 1936–37 amounted to about Rs. 2·57 crores.

The review concludes with a very interesting survey of the sugar trade of Java and Cuba and a description of the world sugar position. A complete list of sugar factories in India has been appended. G. GUNDU RAO.

* * *

International Conference on Whales and Whaling.—The second International Conference held in June 14–24, 1938, should be deemed a success, if only for securing a prolongation of and achieving the adhesion of additional governments to the agreement regarding restriction of whaling arrived at the first Conference held in 1937 (See *Nature*, 1938, **142**, 101–102). The development of the modern factory ship has led to unrestricted whaling, with the result that some species of whales are on the verge of extinction. Thus a resolution which came up for consideration at the Conference was "The Committee, viewing with alarm the evident decline of the stock of Blue Whales, is of opinion that nothing less than limitation of the total amount of whale oil which may be taken in any whaling season can be effective in preserving the stock of the whales from being reduced to the level at which it can no longer be the object of economic exploitation". It was felt however, that at the present stage it would not be possible to reach general agreement on such a measure. There is evidence that the stock of humpback stands in even greater danger of depletion than that of blue whales. The total number of whales taken in the year 1937–38 season was approximately 44,000 or 10,000 in excess of the previous season. The measures of restriction on whaling on which agreement was reached at the 1937 Conference include the imposition of a minimum size limit for various species and the limitation of Antarctic whaling season to three months and with minor reservations, the prohibition of pelagic whaling north of 40° S.

* * *

The Indian Central Cotton Committee.—The Thirty-seventh meeting of the Indian Central Cotton Committee was held at Bombay on 12-13th July 1938. Sir Bryce Burt, presided.

The chief business of the meeting was the consideration of the progress reports on the various schemes financed by the Committee. In the course of his opening speech, the President said: "I have been struck by the very definite information which several progress reports contain of the definite results which have flowed from our research schemes. Not only have positive scientific results been achieved but these have been extended to cultivator's fields on literally, millions of acres,—thanks to the co-operation of the Provincial Agricultural Departments."

The Committee decided to publish annual accounts of the work done on Cotton in India. This decision will be welcomed, not only by those directly engaged in cotton research but also by those whose interests in cotton are not entirely scientific.

The work done at the Technological Laboratory was reviewed and the purchase of new machinery was provisionally sanctioned including a plant for the control of humidity and temperature at the Laboratory, throughout the year. An interim report on the work done in connection with the utilisation of linters, fuzz and cotton waste, etc., for the manufacture of artificial silk, was considered and approved.

* * *

Indian Central Jute Committee—The fourth *Bulletin* of the Committee for July 1938, includes progress notes of the various schemes of the Committee and trade figures for the production and consumption of jute. The Jute Committee's Laboratory for Agricultural Research at Dacca is nearing completion. Under this scheme both the yield per acre and the quality of jute will be dealt with, including work on methods of retting and preparation. The work will definitely be directed to the improvement of the efficiency of raw jute production. The necessary complement to the Agricultural Research scheme is the work of the Technological Laboratory in Calcutta. One of the main functions of the technological research scheme is the testing of strains of jute produced by the Agricultural Research Staff and samples received from other sources.

* * *

The report of the **Botanical Survey of India** for the year 1936–37 contains 3 sections dealing respectively with the 'Systematic' work, Industrial Section of the Indian Museum and Cinchona and Quinine. The facilities for identification afforded by the Herbarium attached to the Survey, has been increasingly availed of by botanists for identification of collections and for the study of special groups of systematic importance. 108 sheets of Asiatic Palms from Singapore and 41 sheets of various flowering plants from Buitenzorg were added to the Herbarium. An interesting acquisition is a sheet of the aquatic *Aldrovanda Vesiculosa* L. presented by Dr. J. C. Sen Gupta of the Presidency College, Calcutta. The contributions made during the year to the systematic knowledge of Indian plants has been briefly reviewed in this section. To the Industrial Section of the Indian Museum, 341 specimens mostly of fibres, spices, oil seeds and medicinal plants obtained from South India, United Provinces and Bombay Presidency, were added during the year. The industrial section fulfils a very important rôle in the development of industries by supplying information regarding the sources of supply of economic plant products. Authentic specimens are supplied for investigations; the roots of *Aconitum heterophyllus* required for research, by Prof. Lawson of the University College, Southampton, were supplied. Under the third section on Chinchona and Quinine, the closing down of the Burma cinchona plantation has been mentioned. All mature bark obtainable from the plantation was stripped and despatched

to the Mungpoo Factory. The supply of quinine from the Indian Museum reveals the interesting fact that while the sale of quinine sulphate tablets dwindled from 1,222 lbs. to 339 lbs., that of cinchona febrifuge tablets rose from 155 lbs. to 1,442 lbs.

* * *

Industrial Research Council.—At the annual meeting held at Madras, 8–9 August, the Council considered the report of the Prizes Committee on the papers received and selected six papers for the award of prizes as follows :—

Rs. 500—'Catalytic hydrogenation of oils'—Mr. S. K. Kulkarni Jatkar, Mr. V. T. Athawale and Mr. J. G. Kane, Indian Institute of Science, Bangalore.

Rs. 250—'Recovery of titanium oxide as a by-product in the manufacture of alumina-ferric from bauxite'—Mr. Sudir Chandra Chakrovarty, M.Sc., Calcutta.

Rs. 250—'Conversion of the standard poly-phase squirrel-cage motor into an internally compensated poly-phase squirrel-cage motor'—Prof. J. J. Rudra, College of Engineering, Saidapet, Madras.

Rs. 150—'Control Instruments for the timber industry. Electric moisture meter for wood'—Mr. D. Narayanamurti, Forest Research Institute, Dehra Dun.

Rs. 150—'Ammonium alum as a catalyst for the production of ether'—Mr. S. K. Kulkarni Jatkar and Mr. T. Subramanya, Indian Institute of Science, Bangalore.

Rs. 150—'Development of metallic lustre (Bronze) on glazed articles made of common Indian plastic clay'—Mr. Sasadhar Roy, M.Sc., Industrial Research Laboratory, Department of Industries, Bengal, Calcutta.

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Nanga Parbat Expedition.—Dr. Paul Bauer, leader of the Nanga Parbat Expedition, returned with all the members, the attempt having been abandoned after reaching Camp 5 " owing to snow and wind ". (see *Curr. Sci.*, 1938, **6**, 581).

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Report of the Food Investigation Board (London), 1936.—This report gives a short summary of seventy-eight investigations carried out by the Food Investigation Staff mainly at the Low Temperature Research Station, Cambridge. The work is mostly concerned with the technical problems concerned in the preservation of foods not usually consumed in India. There is very little of general scientific interest.

R. Passmore.

* * *

How the Santals Live.—At the ordinary meeting of the *Royal Asiatic Society of Bengal* held at Calcutta on Monday, the 1st August, Mr. P. O. Bodding read a paper on the every-day life of the santals. The author who has spent a life-time in the midst of the santals possesses an intimate knowledge of their life. The paper gives an account of the village organization, agricultural activities, social habits, food and clothing.

* * *

National Academy of Sciences.—Sir Shah Muhammad Sulaiman, Judge of the Federal Court, has been unanimously elected President of the National Academy of Sciences, India, at a meeting of the Council and the General Body of the Academy held on Sunday July 17.

The Council of the Academy also decided to award the Education Minister's Gold Medal for the year 1938 to the author of the best paper published in the *Proceedings* of the Academy in the subjects Botany, Zoology and Agriculture.

* * *

Indian Botanical Society.—Dr. Yâjñavalkya Bhâradwâja, M.Sc., Ph.D. (London), F.L.S., F.N.I., Professor of Botany and Head of the Department of Botany, Benares Hindu University, has been elected the Secretary of the Indian Botanical Society in place of Dr. E. K. Janaki Ammal who has resigned.

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We are happy to congratulate **Dr. M. S. Krishnan** on his appointment as Assistant Director of the Geological Survey of India. Dr. Krishnan who has a distinguished record of service as an officer of the Geological Survey, has been called upon, on several occasions, to fulfil responsible offices. He was a member of the Indian Coal Mining Committee of 1937, and President of the Geological Section of the Indian Science Congress, 1936. He has the distinction of being the first Indian to be appointed to this post.

* * *

Dr. Arthur Geddes.—The well-known Geographer from the University of Edinburgh and son of the late Sir Patrick Geddes, is just now on a visit to India making a Geographical Reconnaissance of the Country. He is greatly interested in the ' human ' side of regional geography, and will stay in India for about six months. Seeing that Man has always shown a tendency to live in social groups, a study of the organisation, maintenance and development of this group life will naturally be of great interest, especially when correlated with physical and geographical changes in environment. It is from this point of view that Dr. Geddes proposes to study the regional geography of India, and he has already done some work of this kind in Bengal during his brief visit to this country about ten years back. He is convinced that opportunities for such studies in India are immense, and has now come back to make a longer stay with a view to see more of the country in detail and gather first-hand knowledge in regard to the problems in which he is interested. On the conclusion of this study tour, Dr. Geddes proposes to publish an elaborate monograph dealing with the results of his researches, and we have no doubt that this publication will be a valuable and pioneer contribution in this new and fascinating field of geographical studies in India.

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Medical Congress.—Colonel I. Froilano de Mello, by invitation of H. E. the Minister of Colonies from Portugal, will attend the following Congresses :—

1. Thirty-second **South African Medical Congress** which will be held in Lourenco Marques (Delagoa Bay) under the presidentship of Dr.

Vasco Palmeriim, Director of Medical Service in Mozambique, from 8th to 14th September. The work of this Congress is divided into five main sections: Medicine, Surgery, Obstetrics, and Gynæcology, Public Health and special subjects comprising Ophthalmology, Otology and Laryngology, Dermatology, Venereology, Radiology and Physiotherapy, Anæsthetics, Pediatrics, Psychiatry and Neurology. Many distinguished professors of Johanessburg, such as Prof. W. H. Craid, Dr. W. Russell, Groeber, C. Smith and some of Portugal (Prof. Gentil, Costa Sacadura, J. Porto, Moraes Frias) will attend the Congress. In plenary sessions the following important problems will be discussed :—

"Bronchopulmonary non-tuberculous chronic suppurations from the medical, surgical and radiological points of view.

"Malaria, to which Prof. F. de Mello contributes two papers on experimental treatment of malarial splenomegaly by the method of Ascoli, and treatment and prophylaxis of malaria through chimiotherapy.

Col. de Mello will also read a paper on *Levuroses* in human pathology.

Third **International Congress of Tropical Medicine and Malaria** to be held in Amsterdam from 24th September to 1st October, under the presidentship of Dr. G. Gryns, the section of Malaria being presided over by Prof. N. H. Swellengrebel. The items of this Congress comprise: (1) Deficiency diseases; (2) Filariasis; (3) Leptosperosis; (4) Yellow Fever; (5) Antiplague Vaccination; (6) Amebiasis; (7) Malaria; (8) Rabies; (9) Rickttsiosis; (10) Extermination of Glossinæ.

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Sir Arthur Olver, until recently, Animal-Husbandry Expert, Imperial Council of Agricultural Research, India, has been appointed Principal of the Royal (Dick) Veterinary College, Edinburgh, in succession to Principal Bradley.

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University of Allahabad.—Pandit Amarnath Jha, Head of the English Department, assumed charge of the Vice-Chancellorship on the 8th August, in place of Mr. Iqbal Narain Gurtu, who has gone on leave.

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Travancore University.—A grant of Rs. 8 lakhs was made by the Travancore Assembly for the newly started Travancore University. A sum of Rs. 2 lakhs will be spent for the University buildings and 6 lakhs for current expenditure in the various Colleges and University Institutions such as the Library and Museum.

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University of Calcutta.—According to a *United Press* message the Syndicate of the Calcutta University has decided to start a degree course in Architecture—Bachelor of Architecture—which will be open to any undergraduate of the University.

The course will cover a period of four years, two years for the Intermediate Examination, and two for the Bachelor degree examination. Passed B.Sc. students will be exempted from the first year class of the Intermediate course, but they will have to qualify themselves in the drawings section prescribed for the first year of the Intermediate Examination.

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Benares Hindu University.—According to an *Associated Press* message, at the instance of the U.P. Government, the Benares Hindu University has deputed two experts to Almora and Mirzapur for a survey of mineral possibilities in these hilly tracts. It is stated that copper and iron ores exist in Almora district, but have remained unexplored so far, due mainly to communication and transport difficulties. The government have sanctioned six thousand rupees for the purpose.

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Madras University.—The Degree of Master of Science has been conferred on (1) Mr. N. Subrahmanya Wariyar, in consideration of thesis entitled " A Chemical Examination of Some of the Travancore Plant Products" and (2) K. Lakshmana Rao, in consideration of thesis entitled "Deflection in Reinforced Concrete Structures".

* * *

Dr. B. V. Raghavendra Rao has been awarded the Degree of Doctor of Science by the University of Madras for his thesis entitled " Investigations in Light Scattering and Spectroscopy," which he carried out as a research student of Sir Venkataraman, in the Physics Laboratory at the Indian Institute of Science. We have pleasure in congratulating the young man who, we hope, will be able to carry forward the brilliant researches he has initiated. His work forms an important contribution to our knowledge of light scattering in liquids and the nature of the liquid state. The importance of the results obtained by the author has received handsome recognition from subsequent workers in authoritative journals and reference books, and the British Delegation of Physicists, who had opportunities of examining the work of Dr. Raghavendra Rao, have, in a contribution published in *Nature* (Vol. 141, No. 3562, February 5, 1938) on Scientific Research in India observed that " at the Tata Institute at Bangalore the experiments in the Physics Section on backward internal scattering of light in liquids show a combination of high experimental skill and first-class apparatus."

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Academia de Sciences e Artes, Av. Marechal Floriano, 5, Rio de Janeiro, Brazil.*

Our attention has been recently drawn by Mr. M. T. Chobe, Indian Institute of Science, Bangalore, to a series of articles that appeared in the *Industrial and Engineering Chemistry* (News Edition), exposing the *bona fides* of the Academia de Sciences e Artes. As we have no doubt, that the facts concerning this Academy will interest our readers we are quoting below the relevant portions from Mr. Chobe's letter.

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* Since writing the above, Prof. B. Dasannacharya of the Benares Hindu University has also drawn our attention to the articles appearing in the *Industrial and Engineering Chemistry* (News Edition) regarding the Academy.

" In an editorial of the *Ind. and Eng. Chem.* (News Edn., 1936, **14**, 492) it is stated " We have made careful inquiry through reliable and established channels and learn, . . . that this academy is not a reliable institution.. . . .we expose this swindle in the interest of our readers."

Later, a prominent chemist from Brazil, C. E. Nabuco de Araujo, Jr. writes (*Ind. and Eng. Chem.*, News Edn., 1937, **15**, 132) "this academy is not a reliable institution" and " the Ministry of Labour refused to register the diplomas of chemists granted by that academy, since it is not recognized as an official school. . . . "

Further warning by the Editor of the *Ind. and Eng. Chem.* (News Edn., 1937, **15**, 189): "This is not a reputable institution, and money should not be wasted in securing its proffered degrees."

In spite of these notices, chemists in U.S.A. were still approached. So the Editor reproduced a photograph of the diploma along with the correspondence pertaining to it, as received by the members of A.C.S. (*Ind. and Eng. Chem.*, News Edn., 1937, **15**, 452).

More recently C. E. Nabuco de Araujo, Jr., Caixa, Postal 970, Rio de Janeiro, published a note in the same *Journal* (1938, **16**, 79) wherein he writes: " Because of this exposure the Brazilian Chemical Society, of which I am honorary president, presented a petition to the government requesting that the 'Academia' be closed in accordance with the law regulating the exercise of the chemical profession in Brazil.. . . . . In order to avoid a repetition of such practices, it will be of great help to the Brazilian Chemical Society, if American chemists will call its attention to any future solicitations of like character."

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Professor B. Sahni, F.R.S., Head of the Department of Botany, University of Lucknow, has returned to India after his recent visit to Vienna. We have pleasure in welcoming him.

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We have pleasure in announcing that Dr. Nazir Ahmad, O.B.E., Ph.D., F.Inst.P., Director, Cotton Laboratory, Professor M. R. Siddiqui, M.A., Ph.D., F.N.I., Osmania University, and Dr. Khwaja Habib Hasan, L.Ag., M.Sc., Ph.D., Director, Government Industrial Laboratory, Hyderabad, Deccan, have accepted our invitation to join the Board of Editorial Co-operation, and we welcome this accession of strength to the large body of scientists forming the Board.

Announcement.

The Eleventh **International Congress of Chemists**, will be held in London, in 1941, about the time of the celebrations of the Centenary of the Chemical Society.

The Seventh International Management Congress.—The Seventh International Management Congress will be held at the United States Chamber of Commerce, Washington, from September 19th to 23rd. The objective of the Congress is a free discussion, from a world-wide view-point, of the problems and achievements of management in agriculture, industry and the home. An attempt is made:

(1) to provide a forum for the interchange of management experience in order to increase the efficiency of production and consumption of all forms of goods and services;

(2) to appraise the present situation and probable future course of management in its broader, social and economic aspects;

(3) to provide an authoritative and public reminder to management itself and to the world it serves, of the fact that the only type of management worthy of the name is that which contributes to the welfare of mankind.

Francis Amory Septennial Prize.—In compliance with the requirements of a gift under the will of the late Francis Amory of Beverly, Massachusetts, the American Academy of Arts and Sciences, announces the offer of a septennial prize for outstanding work with reference to the alleviation or cure of diseases affecting the human genital organs, to be known as the "Francis Amory Septennial Prize". The gift provides a fund from which the income may be awarded for conspicuously meritorious contributions to the field of knowledge " during the said septennial period next preceding any award thereof, through experiment, study or otherwise. . .in the diseases of the human sexual generative organs in general". The prize may be awarded to any individual or individuals for work of " extraordinary or exceptional merit " in this field.

In case there is work of a quality to warrant it, the first award will be made in 1940. The total amount of the award will exceed ten thousand dollars, and may be given in one or more awards. It rests solely within the discretion of the Academy whether an award shall be made at the end of any given seven-year period, and also whether on any occasion the prize shall be awarded to more than a single individual.

While there will be no formal nominations, and no formal essays or treatises will be required, the committee invites suggestions, which should be made to the Amory Fund Committee, care of the American Academy of Arts and Sciences, 28, Newbury Street, Boston, Massachusetts, U.S.A.

Seventh International Congress of Genetics.—The Seventh International Congress of Genetics will meet in Edinburgh in 1939, probably August 23 to 30, under the Presidency of Dr. N. I. Vavilov, Director of the Institute of Plant Industry, Leningrad, U.S.S.R. Detailed plans are not yet worked out but it is planned that at the plenary sessions, invited speakers will discuss selected topics such as Animal and Plant Breeding in the light of Genetics, Certain Aspects of the Gene and Chromosome Theory, Polyploidy and Hybridisation in plants, Human Genetics, Properties of the Chromosome. There will probably be sectional meetings dealing with Animal Breeding, Plant Breeding, Physiological Genetics, Human Genetics, Gene and Chromosome Theory and so forth. There will be the usual run of demonstrations, public lectures, official receptions and probably a pre-congress tour. For information, those interested may communicate with

F. A. E. Crew, Esq., Institute of Animal Genetics, West Manis Road, Edingurgh, 9, Scotland.

Epidemic Dropsy.—In a letter addressed to the Editor, *Indian Medical Gazette* (1938, 34, No. 2), Lt.-Col. R. N. Chopra, Director, School of Tropical Medicine, Calcutta, and Dr. R. B. Lal, Director, All-India School of Hygiene and Public Health, Calcutta, have issued an appeal to the Medical Profession for co-operation in the study of the causative principles of Epidemic Dropsy. They write that " India is already ravaged by such diseases as malaria, leprosy and tuberculosis, the loss of life and disablement are appalling. Notwithstanding these scourges, another disease has made its appearance during the last sixty years. It is popularly known as ' beri-beri ', but as it is quite distinct from diseases caused by a vitamin deficiency, it has been labelled as ' epidemic dropsy '. Serious epidemics are fortunately rare, but it has made a more or less permanent home in Bengal, and a large number of people suffer every year. They do get over it temporarily, but a damaged heart is left as a permanent legacy, in most of the cases. Only those people who consume mustard oil are attacked; Sikhs, Marwaris and Europeans on European diet do not suffer at all. All samples of mustard oil are not harmful, but evidences have now accumulated which makes us feel that certain samples of mustard oil have got a poison responsible for the symptoms. It has not been found possible to isolate this poison so far. It is extremely difficult to get those samples of oil which produce swelling of the legs and damage to the heart. We sincerely appeal to the medical profession to help us in the investigation of the causative principles of the disease by putting us in touch with samples of oil which they think are responsible for the causation of the disease. Any information regarding the source of supply of the oil, *e.g.*, the oil mill, etc., will be appreciated. We have no doubt that if the public help us the cause of ' epidemic dropsy ' would be definitely ascertained and the disease totally eradicated."

Sir P. C. Ray 70th Birthday Commemoration Medal.—Applications are invited from Research Chemists *below 30 years of age* for the above competition. Only independent papers, which have been published in the *Journal of the Indian Chemical Society* during 1937, will be considered.

Applications together with 3 copies of reprints of each paper are to reach the Hon. Secretary, Indian Chemical Society, Post Box 10857, Calcutta, not later than *30th September 1938*.

Mysore University.—The Sri Krishnarajendra Silver Jubilee Lecture for 1938 will be given on Saturday, 27th August, at Bangalore, by Rao Bahadur Dr. A. Lakshmanaswami Mudaliar, M.D., F.C.O.G., a leading authority on Gynæcology and Obstetrics. The subject of his address is "The Discoveries of Medical Science and their Effect on Human Welfare".

We acknowledge with thanks, receipt of the following :—

" Agricultural Gazette of New South Wales," Vol. 49, No. 7.

" Journal of Agricultural Research," Vol. 56, Nos. 8–12.

" Indian Journal of Agricultural Science," Vol. 8, No. 3.

" Monthly Bulletin of Agricultural Science and Practice," Vol. 29, No. 6.

" The Phillippine Agriculturist," Vol. 28, No. 2.

" Allahabad Farmer," Vol. 12, No. 3.

" Journal of the Royal Society of Arts," Vol. 86, Nos. 4466–68.

" Biochemical Journal," Vol. 32, Nos. 5-6.

" Biological Reviews," Vol. 13, No. 3.

" Communications from the Boyce Thomson Institute," Vol. 9, No. 4.

" Chemical Age," Vol. 38, No. 991 ; and Vol. 39, Nos. 992–94.

" Journal of Chemical Physics," Vol. 6, No. 7.

" Journal of the Indian Chemical Society," Vol. 15, No. 5.

" Berichte der Deutschen Chemischen Gesselschaft," Vol. 71, No. 7.

" Journal de chemie physique," Vol. 35, No. 5.

" Experiment Station Record," Vol. 78, No. 6.

" Transactions of the Faraday Society," Vol. 34, No. 207.

" Indian Forest Records," Vol. 3, No. 10.

" Forschungen und Fortschritte," Vol. 14, Nos. 20 and 21.

" Genetics," Vol. 23, No. 4.

" Bulletin of the Health Organization (League of Nations)," Vol. 7, No. 2.

" Scripta Mathematica," Vol. 5, No. 2.

" Bulletin of the American Meteorological Society," Vol. 19, No. 5.

" Calcutta Medical Journal," Vol. 34, No. 2.

" Review of Applied Mycology," Vol. 17, No. 6, and Index to Vol. 16.

" Nature," Vol. 141, Nos. 3582–85.

" Indian Journal of Physics," Vol. 12, Part 3.

" Research and Progress," Vol. 4, No. 4.

" Journal of Research (National Bureau of Standards)," Vol. 20, Nos. 2–4.

" Ceylon Journal of Science," Vol. 4, Part 4, Section D.

" Sky," Vol. 2, No. 9.

" Lingnan Science Journal," Vol. 17, Nos. 2 and 3.

" Science Forum," Vol. 3, No. 1.

" Science Progress," Vol. 32, No. 129.

" The Indian Trade Journal," Vol. 130, Nos. 1673–76.

" Journal of the Annamalai University," Vol. 7, No. 3.

ACADEMIES AND SOCIETIES.

Indian Academy of Sciences.

July 1938. SECTION A.—NAZIR AHMAD CHOWDHRY AND R. D. DESAI: *Heterocyclic Compounds. Part VII. Coumarins from Resacetophenone and Cyclic-β-ketonic Esters.*—The condensations have been carried out in the presence of phosphorus oxychloride, with the formation of 7-hydroxy-6-acetyl derivatives of cyclohexano- and octalino-coumarins. M. A. GOVINDA RAU: *Diffraction of Light by Superposed Ultrasonic Waves.*—Pictures are reproduced showing the presence of combinational lines as well as the characteristic manner in which their number and intensities depend upon the intensities of the original spectral orders. P. V. SUKHATME: *An Application of the Bi-partitional Function Hg (P, Q) in the Enumeration of different Samples from Finite Population.* NAZIR AHMAD CHOWDHRY AND R. D. DESAI: *Heterocyclic Compounds. Part VIII. Coumarins from Alkylcyclohexanone-2-carboxylates and* Trans-*β-decalone-3-carboxylate.* K. S. K. IYENGAR: *On Linear Transformations of Bounded Sequences—II.* P. NILAKANTAN: *Magnetic Anisotropy and Pleochroism of Biotite Mica.*—The biotites are highly anisotropic, the anisotropy and pleochroism increasing more than linearly with the ferrous iron content. The pleochroism of biotite is discussed in the light of Saha's view that absorption of light in inorganic salts of elements of the transition series is due to transitions involving the reversal of the spin vector of one of the third electrons of the Catolin.

July 1938. SECTION B.—P. N. MEHRA: *A Study of the Chromosome Number in Some Indian Members of the Family* Codoniaceæ.—The diploid chromosome number in each of the three Indian species *Fossombronia himalayensis* Kash., *Petalophyllum indicum* Kash., and *Sewardiella tuberifera* Kash. is 18, but the morphology of tne chromosomes in each species is different from the other The basic chromosome number in the family *Codoniaceæ* appears to be 9. P. N. MEHRA: *Abnormal Sporocarps in* Marsilea minuta *Linn.*—The megasporangia of the normal type are absolutely lacking in the sporocarp. In the sporangia there are found 16 fairly large irregular angled spores which apparently seem to be non-functional. In others there are observed 16 such large spores and besides a few other comparatively similar spore-like bodies with thick walls. Another interesting fact is that a plant bears either all the normal type of sporocarps or all the abnormal sporocarps. DONTCHO KOSTOFF: *Heterochromatin, Somatic "Crossing-Over" and the Interchange Hypothesis between Non-Homologous Chromosomes.*—An attempt to correlate a series of phenomena, connected with chromosome interchanges and crossing-over. A number of existing theories and hypotheses have been considered in the light of new researches and for a series of phenomenon new interpretations are given which should be considered at present as working hypothesis. S. B. KAUSIK: *Studies in the Proteaceæ.* S. M. SIBTAIN: *Studies on the Caudal Autotomy and Regeneration in* Mabuya dissimilis *Hallowell.*

Indian Association for the Cultivation of Science. (*Proceedings.*)

May 1938.—W. BOTHE: *Hard Cosmic Ray Showers.* S. R. DAS: *A Study of Sulphur Allotropes by the X-Ray Diffraction Method. Part I.* K. BANERJEE AND ABDUL HAQUE: *Space Group of Creatinine.* H. MUKHERJEE: *Determination of the Frequency of the Oscillator with a Condenser.* S. SHARAN: *Magneto Resistance Change of Ferromagnetics in Alternating Magnetic Field.* R. R. BAJPAI AND B. D. PANT: *A Study of the F. Region of the Ionosphere.*

1260-38.—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc A.I.C., A.I.I.Sc. for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore

CURRENT SCIENCE

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Government and Medical Service.

IN a recent public address* Rao Bahadur Dr. A. Lakshmanaswami Mudaliar observed that:

> "Occasionally a discordant note is struck and not infrequently the criticism is levelled against scientific workers that their work is not immediately of benefit to the crying needs of the country, and has no practical value to Statesmen and Politicians, or that their work has only led to the discoveries being utilised for increasing the destructive forces against humanity. That either of these criticisms is not justified will be apparent to any student of science."

Almost simultaneously Lord Rayleigh in the second part of his presidential address to the British Association for the Advancement of Science remarked:

> "Science, it is urged, is the source of all the trouble: and we may look to scientific men for some constructive contribution to finding a remedy. It is worthwhile to enquire what basis there is for this indictment, and whether in fact, it is feasible for men of science to desist from labours which may have a disastrous outcome, or at any rate to help in finding other men to use and not to abuse the fruits of those labours."

Science is primarily the study of Nature in all her moods and tenses and her gifts are absolutely unmoral. They acquire an adjectival character only when man hastens to stand noun substantive to them. The business of science is neither to kill nor to save human life. Its only function is to add to the general stock of knowledge. When we apply this knowledge to human affairs, questions of value arise. In view of the abuse made of certain branches of scientific knowledge, leading to the destruction of civil populations, scientists may perhaps consider the desirability of reverting to the ancient practice of hiding their light under communal bushels; and it may not be unwise to do so, because human society in the middle of the twentieth century is still like a giddy-minded girl whose wisdom has not kept pace with the accumulation of fortunes. It looks as though a new type of society has to merge into being for handling the gifts of science without reproach and with beneficence for all.

* The Sri Krishnarajendra Silver Jubilee Lecture, 1938, University of Mysore.

The Jubilee address was set in a historical background, and the main thesis was "that while curative medicine has got a large part to play in alleviating the suffering and relieving the distress of individuals, it is in the wider field of preventive medicine that the real solution lies for the eradication of disease". Illness has an economic aspect which ought to receive comparatively wider attention in the programme of measures devised by society and governments for ensuring the health and happiness of the civil populations. It must be berne in mind that the economic loss comprehends nct only the monetary cost of combating ill-health, but also the diminishing return due to sickness. If these two sides are added together in order properly to show the purely financial or numerical assessment of the cost of ill-health to the nation, governments may be induced to make a far greater contribution towards the prevention and speedy relief of sickness or disablement in the social community, whose health represents its prosperity. While reflecting the rapid changes taking place around us, we sometimes wonder how far and in what manner a government's capacity for service to its citizens in this direction is conditioned by its form. We are not indifferent to the converse study,—in the manner and the degree in which the citizen must serve his government in order that the fullest possibilities of government may be achieved. The capacity of the citizen at once to serve the government and to be guided by it, and thus to make of government a living partnership is, we think, dependent upon a wider, more explicit and more continuous education of the public than now obtains in the fundamental concerns upon which both government and the life of the individual citizen are predicated. Without such co-operation we must continue to have a people whose health, education and employability would be eternally irritating problems.

Dr. Lakshmanaswami Mudaliar has given an enhanced conception of what national health really is, which is one of a very positive nature. It relates not only to the absence of diseases, and the proper functions fulfilled by the members of the community, but it embraces the sum total of human personality. It concerns not only with the bodily structure, but with every fibre of the mind and even with character. The responsibility in promoting these wider aims, fuller conceptions and increased values is mainly to be shared by the medical profession, governments and the individuals. The Jubilee Lecture emphasises the immediate medical responsibility arising from the results of recent research in medicine, surgery and the allied sciences, the possibilities of which have been realised in immunisation against epidemics or infective diseases, the functioning and control of the neuro-endocrine system, the new psychological approach to the study of the human mind, and the treatment of civilisation disorders, the analysis of food-stuffs and the fundamental importance of vitamins and the new science of genetics, disclosing the nature and mechanism of human heredity. Do the politicians who control the destiny of large populations, have the necessary acquaintance with the contributions which the human sciences are making to the social problems, which they have to study and solve. It seems to us that viewed from the wider standpoint the responsibility of maintaining and improving the health of a population has passed from the medical profession to government action. Yet the paramount responsibility of the individual for his own health and for his own local environment remains. The efforts of the medical profession and of governments are easily nullified by individual ignorance and unwisdom. We consider that more than "Wardhaising" our schools, a definite curriculum for the inculcation of health habits in the elementary schools, the instruction in biology, hygiene and health knowledge in the higher stages, and the encouragement and training in health wisdom in the later years of education would seem to be urgently called for, and such a policy might undoubtedly prove more significant to the interests of the community, than the futile efforts to solve the "Babeldom" of India.

Social and International Relations of Science.

In a series of brilliant editorials in *Nature*, followed by a comprehensive Symposium[1] on Social and International Relations of Science, Sir Richard Gregory has been advocating that steps be taken to formulate the immediate purpose of science into a logical and constructive programme of work for the betterment of human relations and conditions of existence. The result of Sir Richard Gregory's action has been a wide awakening of consciousness among scientific workers that their interest in the promotion of social well-being and international cordiality is both profound and positive. Accordingly proposals for investigations of the social and public problems on an international basis have been favourably received by scientists in America and in most of the European countries. The outcome of this general movement has found expression in the establishment of a new Division by the British Association for the Social and International Relations of Science. We reproduce below the memorandum prepared for the consideration of the General Committee.

I. Proposal for the Establishment of a New Division.

At the present time a strong feeling exists that the social relations of science demand close and objective study. The question has been dealt with recently in the press and elsewhere. At an informal meeting of persons specially interested, it was stated that there is nothing in the constitution of the British Association to prevent the establishment of machinery within that organisation for the purpose desired. A resolution was thereupon addressed from this meeting to the Council of the Association, inviting the Association to establish a special department which would consider the social and international relations of science, by means of enquiry, publication, and the holding of meetings not necessarily confined to the annual meetings of the Association.

International relations were specified in this resolution primarily because of the deep interest of the American Association for the Advancement of Science in the subject. Discussion is expected to take place between officers of the two Associations, during the present summer, on the best means for international co-operation.

The Council supported the proposal to establish an organisation for these purposes within the Association. They appointed a Committee to formulate a scheme for the working of such an organisation, to be presented to the General Committee at the Cambridge Meeting. It is thought that the organisation should work on lines in some respects different from those of a Section, and should not bear that title. The term Division is therefore recommended.

The purpose of the Division would be to further the objective study of the social relations of science. The problems with which it would deal would be concerned with the effects of advances in science on the well-being of the community, and, reciprocally, the effects of social conditions upon advances in science.

The Division would be worked by a Committee, nominated annually by the Council and appointed by the General Committee. The Council should have power to appoint additional members of the Committee during the year.

The Committee should embody the existing British Science Guild Committee of the Association, inasmuch as the Norman Lockyer, Alexander Pedler, and Radford Mather Lectures, now administered by that Committee, would appropriately come within the purview of the Division.

The President of the Association and the General Officers should be *ex-officio* members of the Committee. A Chairman of the Committee should be appointed for a fixed period of office. A fixed proportion of the ordinary members of the Committee should retire annually (as in the case of the Council) and should not be eligible for immediate re-election.

The functions of the Committee would be:

(*a*) To arrange meetings of the Division both at the time and place of the Annual Meetings of the Association, and elsewhere at other times, as invited or otherwise arranged; to appoint speakers, and to accept or reject communications offered to the Division.

(*b*) To furnish material for the information of the public.

(*c*) To co-ordinate work dealing with the social relations of science, both at home and abroad.

(*d*) To be prepared to act in a consultative capacity and to supply information, and to that end to establish relations with organisations and persons engaged in practical administration.

(For the furtherance of the above objects, the Committee, immediately upon the establishment of the Division, should issue an announcement thereof, together with a reasoned statement of its aims, to institutions and other organisations and individuals known or likely to be interested in its work.)

(*e*) To set up sub-committees for executive purposes, or for research, enquiry, or co-ordination. If any such sub-committee should require a grant of money for its work, the Committee should be empowered to apply for such grant to the General Committee or the Council in accordance with the usual procedure relating to research committees.

(*f*) To maintain close relations with the Sections of the Association and their Organising Committees. In particular, there may be imagined subjects which two or more Sections might be

[1] *Nature*, Saturday, April 23, 1938, **141**, No. 3573.

disposed to recommend to the Division for discussion, in lieu of arranging joint meetings of the Sections. The Committee of the Division, on its part, should be enabled to invite the advice of the sectional organisations on all appropriate questions. The Organising Sectional Committees should be kept regularly informed of the activities of the Division.

The Committee should meet regularly throughout the year, at intervals determined by itself, and in particular it should hold a meeting at or near the time of the joint meetings of Organising Sectional Committees in January, in order to assure the relations with the Sections referred to above.

The Committee should report to the Council as and when necessary, and annually through the Council to the General Committee.

II. PROPOSAL FOR A QUARTERLY REPORT.

In November 1937 the Council directed the General Officers to consider and report upon the format and printing of the Report of the Association. Subsequently, the Committee which was appointed to formulate a scheme for the new Division referred to above was instructed also to consider and report upon the whole question of publication by the Association.

The Committee, after considering various schemes in detail, recommend that as from the year 1939–40 the Annual Volume should be superseded by a Quarterly Report. The Annual volume following the Cambridge Meeting would thus be the last of its series.

The principal considerations which have led the Committee to make this recommendation are as follows:

Quarterly publication should go far to overcome the widespread belief that the British Association is inactive except during its annual meeting. The fact that it now administers the Norman Lockyer, Alexander Pedler, and Radford Mather Lectures (which are given at times and places other than those of the annual meetings) points to the desirability of publication at less than annual intervals; and the establishment of the new Division on the lines recommended would strongly reinforce this argument.

Quarterly publication would provide the means of keeping members and the public informed as to the activities of the Association, as an annual volume cannot. Quarterly publication should achieve a wider circulation than the annual volume does for individual communications which call for a wider publicity than they receive by inclusion in an annual volume.

It is recommended that the Quarterly should appear in October, January, April and July. The size proposed is royal octavo (approximately $10 \times 6\frac{1}{2}$ in.). It is suggested that the title *The Advancement of Science* should be transferred to the Quarterly from the present publication which bears that name and contains the presidential address given at the annual meeting. In substitution for the publication of all these addresses together, it is proposed to issue individual addresses separately, at the time of the meeting.

The bulk of the material made available from the annual meeting would appear in the October and January numbers. There should, however, be the fullest possible measure of elasticity. This consideration might be expected to apply especially to the reports of research committees, for which delayed publication is sometimes found desirable; or on the other hand publication in advance of the meeting at which a particular research is to be discussed might be allowed at the discretion of the appropriate Organising Sectional Committee.

It is considered that the Journal of Sectional Transactions, as at present issued at the annual meeting and subsequently incorporated in the Annual Report, is of little value as a permanent record. It is proposed that the present Programme and Timetable should include the programme of each Section separately (as the Journal does now), with abstracts of the briefest possible nature, or none where titles of communications would suffice alone. The transactions of the Sections should be reported in the Quarterly in narrative form, and so far as finance would allow there should be additional opportunity for publication *in extenso* or full abstract, and for the reporting of discussions.

No changes in the terms of membership subscription are recommended; life members and annual members now entitled to receive the Annual Report would receive the Quarterly. The price of 3*s.* 6*d.* per part is recommended for non-subscribers.

The Quarterly should be marketed by arrangement with a publishing firm.

The division into quarterly parts would in itself cost little more than the annual volume, even allowing for improvement of the format. Additional matter for publication, however, would be expected from the new Division and from more effective reporting of the work of the Sections. The establishment of the new Division would increase clerical work in the office. On these considerations it has been estimated that the proposals here made might involve the Association in an additional annual expenditure of £400–500 in a few years' time; and in this event a temporary draft upon capital would be necessary.

It is hoped, however, that such additional expenditure would be offset by increased sales of the Quarterly and reports of the Presidential Addresses, as against those of the Annual Volume and the present *Advancement of Science*, and also by receipts from advertisements in the Quarterly. Moreover, the establishment of the new Division and the publication of a Quarterly are both measures which should help to increase the membership of the Association.

Meine geophysikalischen Arbeiten in Zentral—Asien.

von Prof. Dr. W. Filchner.

ZWECK meiner letzten drei Expeditionen nach USSR. China, -Tibet und Indien war die magnetische Erforschung eine der bisher—im magnetischen Sinne—unbekannten Flecken der Erde. Er umfasst ein Gebiet innerhalb: Pamir, Himalaya, Dsungarei und Schanghai. Meine magnetischen Arbeiten haben sich nur mit der Erforschung des Baues und der Bewegungen der Erdkruste befasst.

Meinen magnetischen Arbeiten lag ein peinlich genau ausgearbeitetes Messprogramm zugrunde, zu dessen Durchführung besonders die zwei letzten Expeditionen nötig waren, eine in den Jahren 1926 bis 1928 und eine 1934 bis 1938.

Auf der ersten Expedition habe ich eine Messkette von Taschkent aus über Kuldscha —Ti-hua—Hami—Su-tschou — Lantschou — Küke-nör—Tang-la nach Nag-tschu-ka (etwa 200 km. nördlich Lhassa) gelegt und von hier aus über Schen-ssa-dsong-Gartok nach Leh. Auf dieser Messkette folgen die ermagnetischen Stationen in Abständen von 20 bis 30 km. Von jeder Station musste die astronomische Position bestimmt werden und im Anschluss daran das Azimut. An den somit festgelegten astronomischen Fixpunkten wurden folgende magnetischen Elemente mit dem grossen magnetischen Theodoliten festgelegt: Deklination, Horizontal-Intensität und Vertikal-Intensität. Auch wurden täglich die Schwingungen durchgeführt. Alle 100 bis 200 km. wurde mit Hilfe des grossen magnetischen Theodoliten, eines Erdinduktors und eines Galvanometers die Inklination, etwa alle 70 km. würden die Konstanten bestimmt. Alle 100 km. wurden hierbei zwei Ablenkungsmagnete benutzt.

Im ganzen habe ich auf der erwähnten Strecke 157 magnetische Stationen errichtet. Die Messung auf einer Station dauerte bei günstigen Verhältnissen etwa 3, bei ungünstigen bis zu 20 Stunden.

Durch diese Messungen konnte gerade im Küke-nör-Gebiet das theoretisch so interessante Umschlagen der Variation der Horizontal-Intensität erkannt werden.

An einigen Punkten, auf denen schon früher von mir oder anderen Forschern erdmagnetische Beobachtungen ausgeführt worde waren, habe ich Wiederholungsmessungen gemacht, die der Bestimmung der Schwankung der Säkular-Variation, d.i., der Prüfung der fortschreitenden Veränderung der magnetischen Elemente zugute kommen. Meine Beobachtungen sind die ersten, in so umfangreicher Weise, in Zentral-Asien ausgeführten. Damit die Messpunkte jederzeit wieder aufgefunden werden und auf ihnen die magnetischen Messungen wiederholt werden können, habe ich von jedem Messpunkt (Station) und Umgebung eine Ortsskizze angefertigt.

Die unbedingte Voraussetzung für die Exaktheit der Messungen war die Prüfung und Eichung der Instrumente in der Form von Anschlussmessungen in Potsdam bzw. Niemegk und in Dehra-Dun in der Survey of India, wobei mir folgende Herren der Survey of India stets die weitestgehende Unterstützung hatten zuteil werden lassen: Der Direktor der Survey of India Colonel C. M. Thompson, Major G. Bomford, R. E., Dennis Kingston Rennick, M.B.E. Rai Sahib R. B. Mathur, B.A., und Shiam Narain, B.Sc.

Die Beobachtungsergebnisse meiner ersten Expedition, deren Verlauf bereits angegeben wurde, liegen heute bereits ausgearbeitet vor. Sie lassen erkennen, dass das Küke-nör-Gebiet von der Null-Isogone geschnitten wird, dass es also eine Zone ist, in der die Deklination aus der östlichen Abweichung in die westliche umschlägt. Sie lassen weiter den mit Resultaten aus den Schweremessungen übereinstimmenden Schluss zu, dass das magnetitreiche Urgebirge in Tibet in grosser Tiefe liegt.

Die etwa 6000 km. lange Wegstrecke meiner ersten Expedition zeigt die Form einer Schleife und fixiert in dieser Form, kathographisch gedeutet, nur eine *lineare Verteilung* der erdmagnetischen Ergebnisse.

Um aber die erdmagnetische Situation Zentral-Asiens *flächenmässig* zu erfassen und die magnetische Erschliessung eines weiten Bereichs in grossen Zügen zu vollenden, unternahm ich in den Jahren 1934 bis 1938 eine zweite Expedition, die den Zweck verfolgte, mitten durch die ellypsenartige

Schleife der ersten Expedition, und zwar von Lan-tschau aus entlang der Längsachse O–W, eine Messehne westwärts entlang Kükenör, Tsaidam, Ajak-kum nöl, Tschertschen bis nach Chotan zu legen, hier Anschluss an die magnetischen Beobachtungen Piewzoffs zu finden und diese Messkette von hier aus bis nach Leh zu verlängern. Auch bei dieser Expedition sind alle Instrumente vorher und nachher mit den Normalapparaten in Potsdam bzw. Niemegk und Dehra-Dun verglichen worden. Diese zweite Expedition war auf zwei Jahre geplant. Es wurden aber vier Jahre daraus, da sich mir die grossen und kleinen Schicksale, Zwischenfälle, Widerstände und Verwirrungen mit weit grösserer Treue und Beharrlichkeit an die Fersen hefteten, als ich willens war, gelassen zu ertragen.

Auf diesser zweiten Expedition habe ich an Stellen, wo ich mich etwas länger aufhalten konnte, auch die Schmidt'sche Feldwaage benutzt und mit ihr kleinere Gebiete mit einem Netz von Feldwaagemessungen überzogen. Dauernd sind die verschiedenen Magnete und Kompensationsmagnete untereinander verglichen worden und ab und zu sogar auf den Schienen des magnetischen Theodoliten nachgemessen worden.

Durch die Messungen der zweiten Expedition ist erreicht worden, dass die lineare Verteilung der erdmagnetischen Ergebnisse zu einer *flächenhaften* erweitert werden konnten und dass es somit jetzt möglich geworden ist, vom Gebiet innerhalb der Plätze Taschkent—Ti-hua–Lan-tschau—Lhassa eine *magnetische Karte* zu entwerfen. Die magnetischen Ergebnisse dieser beiden Expeditionen werden aber auch praktisch von Nutzen sein für Vorarbeiten für Eisenbahn-, Strassen- und Wasserbau, für Bodenforschung, sowie für das Flugwesen, die Ingenieurwissenschaft und den Bergbau.

Neben diesen magnetischen Arbeiten habe ich auf Bitten der Aero Survey des chinesischen Generalstabs in Nanking auch noch Arbeiten ausgeführt, die der Luftbildmessung der von mir durchreisten Gebiete zugute kommen sollen. Es sollten an die von mir fixierten astronomischen Punkte bzw. an das Azimut dieser Punkte alle markanten Geländepunkte der Umgebung angeschlossen werden und ausserdem vom Stationspunkt und dessen Umgebung jeweils eine Ortsskizze hergestellt werden. Dadurch würde man später sowohl die von mir astronomisch bestimmten Punkte, als auch die an sie angeschlossenen markanten Geländeobjekte leicht auffinden können. Die von mir geschaffenen Fixpunkte könnten also leicht in die Flugbildaufnahmen übertragen werden und die letzteren damit in einem festen astronomischen Rahmen verankert werden.

Die Genauigkeit meiner astronomischen Beobachtungen ist eine für den angestrebten Zweck durchaus hinreichende. Die Breiten der auf der zweiten Expedition gewonnenen Werte stimmen auf Bruchteile einer Bogenminute und mit Hilfe eines in Zi-ka-wei in der Jesuitensternwarte gebauten Kurzwellenempfängers gewonnen Längen haben mindastens eine Bogenminute Genauigkeit. Es standen mir sechs Chronometer und zwei Stoppuhren zur Verfügung, die im allgemeinen zweimal täglich mit Nauen, oder Moskau, Buenos Aires oder Cavite, dem Kriegshafen von USA, verglichen wurden. Von den Chronometern hatten zwei 1/2-Sekundenschlag. Die genauen Ortsbestimmungen sind für die Kartographie Zentral-Asiens wichtig.

Im ganzen habe ich auf den beiden letzten Expeditionen in Zentral-Asien etwa *520* magnetische Stationen geschaffen. Von diesen entfallen auf die letzte Expedition etwa 360 Stationen. Die Berechnung der erdmagnetischen Ergebnisse liegt in den Händen von Prof. Dr. O. Venske, Potsdam und diejenige des astronomischen Teils in den Händen von Prof. Dr. E. Przybyllok, Königsberg. Spätestens in zwei Jahren dürften die ganzen Messungen berechnet sein.

[The object of Prof. Filchner's last expedition to USSR, China, Tibet and India was the magnetic investigation of a region so far not magnetically surveyed. It includes the regions between Pamir, Himalaya, Sungaria and Shanghai.

On the first expedition during 1926-28, Prof. Filchner established a chain of observation posts from Tashkent to Nagchu (about 200 km. north of Lhasa) through Kulja, Tihua, Hami, Suchow, Lanchow, Kokonor and Tangla. On this chain the stations lay at distances of 20 to 30 km. The astronomical position of each station was determined and the azimuth was related to this. The following magnetic elements—declination, horizontal intensity and vertical intensity—were determined by means of a large magnetic theodolite. Oscillations were also observed daily. After every 100 to 200 km. the inclination was determined with the large magnetic theodolite and an earth inductor and galvanometer, the constants being determined every 70 km. After every 100 km., two deflecting magnets were used for this purpose.

The stations established during the first expedition

were *linearly* distributed along a loop. In order to complete a survey of the whole *area*, a second expedition was undertaken during 1934–38, with the object of establishing a series of posts on an East-West axis from Lanchow along Kokonor, Tsaidam, Ajak-kumnöl and Cherchen to Chotan, and connecting up here with the magnetic observations of Piewzoff and extending this line up to Leh. This time, as in the previous expedition, the instruments were compared with standard ones at Potsdam, Niemegk and Dehra Dun before and after the Survey. This expedition was planned for two years but on account of a number of difficulties it actually lasted four years.

On the whole 520 stations have been established, of which about 360 were founded during the recent expedition. The reduction of the magnetic observations is in the hands of Prof. Dr. O. Venske of Potsdam, and that of the astronomical observations has been taken up by Prof. Dr. E. Przbyllok of Konigsberg. All the observations may be reduced, at the latest, within two years.]

Donnan Equilibria in Biological Processes.

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Introduction.

THE expression 'Donnan Equilibrium' or 'Membrane Equilibrium' is used to represent the state of thermodynamical or statistical equilibrium, between two homogeneous fluids separated by a membrane. The two fluids are at the same temperature and the membrane is permeable for some molecules or ions present in the two fuids but not for all. In other words, the Donnan Equilibrium deals with a system in which a mass of solvent is divided by a membrane into two phases, both of which contain *e.g.*, diffusible ions, and one of which contains a non-diffusible ion. The presence of the non-diffusible ions or molecules leads to an unequal distribution of the diffusible ions or molecules on the two sides of the membrane.

The study of the membrane equilibria is a well-known branch of physical chemistry. We get osmotic equilibria if the membrane is permeable only by the solvent. The conditions of this equilibria were studied by Willard Gibbs[1] in 1878, and according to him the chemical potential of the solvent must be the same on the two sides of the membrane. Gibbs' application of thermodynamics to the membrane equilibria, however, remained unnoticed for a very long time. In the year 1890, soon after the ionic theory of Arrhenius was known, William Ostwald[2] suggested the study of two solutions separated by a membrane, which allows some ions, but not all ions to pass through. In 1910, Donnan and Harris[3] made a detailed examination of the molecular state of congo red in aqueous solution by means of measurements of osmotic pressure. They found unequal distribution of sodium and chlorine ions, and suggested that this behaviour may be explained with the help of thermodynamics. The thermodynamical theory of membrane equilibria was first developed by Donnan[4] in 1911. In this form the theory was applicable to dilute solutions in the ideal form. More recently Hückel[5] and Donnan and Guggenheim[6,7] have revised the theory to make it applicable to imperfect solutions of electrolytes and non-electrolytes. This equilibrium theory has been re-examined by Gatty[8] in terms of the number of degrees of freedom of systems containing any number of chemical components and containing any number of membranes. The statistical theory of such membrane equilibria has been worked out by Ganguli.[9]

The theory of Donnan has been applied to very many special problems, and we shall mention here only a few of such

[1] Gibbs, *Collected Works*, 1928, **1**, 83.

[2] W. Ostwald, *Zeit. Physik. Chem.*, 1890, **6**, 71.

[3] Donnan and Harris, *Journ. Chem. Soc.*, 1911, **99**, 1554.

[4] Donnan, *Zeit. Elektrochem.*, 1911, **17**, 572.

[5] Hückel, *Kolloid Zeit.*, 1925, **36**, 204.

[6] Donnan and Guggenheim, *Zeit. Physik. Chem.*, (A), 1932, **162**, 346.

[7] Donnan, *ibid.*, 1934, **168**, 369.

[8] Gatty, *Phil. Mag.*, 1934, **18**, 273.

[9] A. Ganguli, *Kolloid. Zeit.*, 1934, **67**, 304.

applications. Thus Liu[10, 11] has discussed the theory in conjunction with the activity co-efficient of electrolytic solutions. The effect of adsorption of solute and solvent by the membrane on the direction of osmosis of systems not in equilibrium, and a classification of such systems has been given by Schreinemakers and Werre.[12] They have also discussed the properties of mosaic membranes whose permeability varies from point to point. The latter effect and its relationship to negative osmosis has been discovered by Söllner,[13] while the properties of membranes that are capable of doing work have been discussed by Straub.[14]

Now if we try to apply the theory of Donnan to biological processes we are confronted with a difficulty. All the biological processes are characterised by life and the living cell is really a physico-chemical transformer which assimilates various substances, and maintains itself in its dynamically stationary state. But any system at constant temperature obeying the laws of thermodynamics must tend towards that configuration in which its free energy is minimum. That is, a system cannot maintain its dynamically stationary state and at the same time obey the laws of thermodynamical equilibrium, or only non-living systems can be in a state of thermodynamical equilibrium. It would appear from this that it is not permissible to apply the theory of Donnan to the living cells. There is, however, a loop-hole in this argument and we can argue, that all living organisms are not living to the same extent, that is, do not possess the same amount of free chemical energy. Some parts of an organism may possess an amount of free chemical energy, which is equal to that which that part would be required to possess if the system obeyed the laws of thermodynamics. The theory of the membrane equilibria is strictly applicable only to those parts of a living organism where the free chemical energy is a minimum. The greater the deviation of the actual free chemical energy of the system from the minimum chemical energy, the greater would be the inapplicability of the laws of Donnan to such a system. But even in such extreme cases we can say that the theory of Donnan equilibria if applied to biological processes is likely to give us some indication of the actual physico-chemical changes that are brought about in an organism.

Warburg[15] was the first to apply the theory of Donnan equilibria to red blood corpuscles. Considerable progress has been made in this direction by L. J. Henderson,[16] D. D. van Slyke[17] and their collaborators. Donnan's method has also been applied with success to various other biological processes. In this article we shall first consider the thermodynamics of the Donnan equilibria and then we shall turn our attention to some typical biological applications of the same. We shall also try to get a picture of the physico-chemical processes which must be accompanying the biological processes.

Osmotic Equilibrium.[18]

Membrane equilibria arise when two solutions are separated by a membrane which is permeable for some of the components but not for all. The most familiar case is that of an ordinary osmotic equilibrium where there are two components, the membrane being permeable for one (called the solvent) but not for the other (called the solute). In the simplest case of this type of equilibrium, the solution is present on one side of the membrane, the pure solvent on the other, *i.e.*,

Solution	Pure Solvent
Pressure $= P_1$	Pressure $= P_2$
(1)	(2)

If the hydrostatic pressures P_1 and P_2 (supposed uniform on both sides) are equal, the solvent diffuses from (2) to (1) and the solution phase (1) swells in volume.

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[10] Liu, *Kolloid. Zeit.*, 1931, **57**, 139 and 285.

[11] Liu, *ibid.*, 1932, **58**, 144.

[12] Schreinemakers and Werre, *Proc. Aka. Amsterdam*, 1932, **35**, 42 and 162.

[13] Söllner, *Biochem. Zeit.*, 1932, **244**, 370.

[14] Straub, *Chem. Weekblad*, 1930, **27**, 672.

[15] E. Warburg, *Biochem. Journ.*, 1922, **16**, 153.

[16] L. J. Henderson, *Blood, a Study in General Physiology*, Dresden, 1932.

[17] D. D. van Slyke, *Factors affecting the Distribution of Electrolytes, Water and Gases in the Animal Body*, London, 1924.

[18] F. G. Donnan, *Journ. International Soc. Leather Trades' Chemists*, 1933, **17**, 136.

For any given temperature this osmotic movement of the solvent molecules can be prevented by sufficiently increasing P_1 or lowering P_2. For equilibrium if the phase (1) can be treated as an ideal solution,

$$P_1 - P_2 = \frac{RT}{V_0} \log \frac{1}{N_0} \quad \ldots \quad (1)$$

where N_0 = mol. fraction of the solvent in the solution (1) and V_0 = increase in volume of an infinite mass of solution on adding to it one mol. of the solvent. If the solution is an ideal one (as supposed) and if we neglect the compressibility of solution and solvent, then we can state that V_0 is simply the volume of one mol. of the pure liquid solvent at the temperature T. The pressure difference $\pi = P_1 - P_2$ is called the osmotic pressure of (1) against the pure solvent. We may write the foregoing equation in the form

$$\pi = -\frac{RT}{V_0} \log (1 - N_s) \quad \ldots \quad (2)$$

where N_s = mol. fraction of the solute in the solution (1) at equilibrium, since $N_0 + N_s = 1$. This equation is valid for all concentrations of an ideal solution. If the solution is dilute enough to justify the neglect of higher powers of the fraction N_s in the series expansion of the logarithmic term $\log (1 - N_s)$, then we may write

$$\pi = \frac{RT}{V_0} N_s = \frac{RT}{V_0} \frac{n_s}{n_0 + n_s} \quad \ldots \quad (3)$$

where n_s and n_0 are the mol. numbers of solute and solvent respectively in solution (1) at equilibrium. If we may neglect n_s in comparison with n_0 then we obtain

$$\pi = RT \frac{n_s}{n_0 V_0} \quad \ldots \quad (4)$$

where $n_0 V_0$ = volume of the solvent employed. We may employ this equation as it stands or introduce molar volume concentrations.

If the solutions are not ideal, we must write the original equation in the form

$$\pi = \frac{RT}{V_0} \log \frac{1}{N_0 f_0} \quad \ldots \quad (5)$$

where f_0 = the activity coefficient of the solvent. We may also write this equation in the form

$$\pi = \frac{gRT}{V_0} \log \frac{1}{\ } \quad \ldots \quad (6)$$

where g is called the osmotic coefficient of the solution.

In general when a membrane equilibrium occurs, some of the solute components, *i.e.*, the ones for which the membrane is permeable will be present in the solutions on both sides of the membrane.

Thermodynamical Equilibrium in Simple Systems.[19–22]

The theory of Donnan in its original form[4] is applicable only to dilute ideal solutions of dissociated electrolytes. (The solutions are said to be ideal when the interaction between the molecules of the solute can be neglected, further the interaction between the molecules of the solute and the solvent is independent of the concentration.) In this simple form the theory has been applied to a large number of biological processes. Let us first consider the two types of biological processes, those that are likely to show thermodynamical equilibria, and those which can show chemical equilibria.

According to the laws of diffusion, such substances as salts and sugars, which are soluble in water and are absorbed by the cell, must continue to enter the cell until the concentration of each substance becomes equal, both outside and inside the cell. As the plant usually obtains rather dilute solutions of nutritive substances, it is evident that their entrance into and accumulation within the cell require special conditions. A most important pre-requisite is the chemical change of the absorbed substances. For instance, when carbohydrates are stored in the tubers of the potato, the sugar obtained by the cells from the leaves is transferred directly into starch, which is insoluble in water. The concentration of sugar in the cells of the growing tuber is therefore extremely low and does not impede the diffusion of new amounts of sugar. The same is observed in ripening oil-bearing seeds. The only difference in this case is

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[19] F. G. Donnan, *Kolloid. Zeit.*, 1932, **61**, 160.

[20] T. R. Bolam, *Kolloid. Beihefte*, 1934, **39**, 139.

[21] Padoa and Tedeshi, *Biochem. Zeit.*, 1933, **266**, 452.

[22] Maximow, *Text-book of Plant Physiology*, McGraw Hill, 1930, 119.

that the fats are now accumulated at the expense of the soluble carbo-hydrates. Protein compounds are formed from amino acids and so on. As a general rule, the substances entering the cell are subject to chemical transformation which assures their uninterrupted absorption.

This general mechanism of the absorption and accumulation of substances in the cell, however, does not always hold true. There are cases when solute substances accumulate in great quantity, and remain in the same state in which they are when entering the cell, for example, in the bulb of the common onion, are stored considerable amounts of glucose. In pigweed and other plants much potassium nitrate accumulates. At the present time, the explanation of these phenomena is sought in the so-called membrane equilibria of Donnan.

If a membraneous sac impermeable to colloids containing a readily ionisable salt, one of whose ions is of a colloidal character, such as sodium proteinate—a sodium salt in which the rôle of an acid is played by some protein—is immersed in water, the sodium ions though able to pass through the membrane, will not diffuse out of the sac, being retained by the electrostatic attraction of anions and cations. If some easily penetrating salt is added to water, for instance sodium chloride, then in the process of osmosis the Na^+ and Cl^- ions will diffuse through the septum and finally there will be established an equilibrium.

To apply thermodynamics to these processess, let us consider the solution of a salt NaR, separated from the solution of NaCl by a membrane, and let us suppose that the membrane is permeable for all particles except the anion R^- and the undissociated salt NaR. The initial and the final states may be represented diagrammatically as follows. The vertical line represents the membrane.

Initial State.

Na^+	R^- (Proteinate)	|	Na^+	Cl^-
C_1	C_1	|	C_2	C_2
(concentrations of the ions)		|		
	(1)	|	(2)	

Final State.

Na^+	R^-	Cl^-	|	Na^+	Cl^-
$C_1 + X$	C_1	X	|	$C_2 - X$	$C_2 - X$
	(1)		|	(2)	

The resultant electrical charge on each side of the membrane must be zero and hence

$$(Na^+)_1 = (Cl^-)_1 + (R^-)_1$$
$$\text{and } (Na^+)_2 = (Cl^-)_2$$

Further, as the system is in equilibrium, the work done in taking equal quantities of Na^+ and Cl^- ions in the same direction must be equal, hence

$$dn\ RT \log \frac{(Na^+)_2}{(Na^+)_1} + dn\ RT \log \frac{(Cl^-)_2}{(Cl^-)_1} = 0 \quad (7)$$

Therefore in the state of equilibrium

$$(Na^+)_1 \times (Cl^-)_1 = (Na^+)_2 \times (Cl^-)_2$$

This unequal distribution of the charged particles gives rise to a difference of potential E on the two sides of the membrane,

$$E = \frac{RT}{F} \log \frac{(Na^+)_2}{(Na^+)_1} \quad .. \quad .. \quad (8)$$

This difference of potential which may be supposed to be localised on the membrane is called the membrane potential. F = Faraday's equivalent in volt-coulombs. This difference of potential can also be expressed in terms of Cl^- ions, and we get

$$E = \frac{RT}{F} \log \frac{(Cl^-)_1}{(Cl^-)_2} .. \quad .. \quad .. (8\ a)$$

The expression for E in terms of any positive ions will be similar to 8, while any negative ions will be similar to 8*a*. Hence we get

$$\frac{(A^+)_1}{(A^+)_2} = \frac{(B^+)_1}{(B^+)_2} = \frac{(C^-)_2}{(C^-)_1} = \frac{(D^-)_2}{(D^-)_1} \quad .. \quad (9)$$

Similarly, by applying the equation 7 we get for doubly charged positive ions, if simultaneously present with singly charged sodium ions, the relation

$$\frac{(Ca^{++})_1}{(Ca^{++})_2} = \frac{(Na^+)_1^2}{(Na^+)_2^2} \quad .. \quad .. \quad .. (9\ a)$$

We can also express the membrane potential E in terms of the corresponding pH values

$$E = \frac{RT}{F} \log \frac{(Na^+)_2}{(Na^+)_1} = \frac{RT}{F} (pH_1 - pH_2) \quad .. \quad (10)$$

Let us apply these considerations to the case of NaR and NaCl which has been already represented by a diagram. According to Donnan, at equilibrium the products of the concentrations of the diffusible ions must be equal on both sides of the septum. Then we get

$$(C_1 + X)\,X = (C_2 - X)^2$$

From this equation may be calculated the relation between the ions of sodium and of chlorine on both sides of the septum. This calculation shows that higher the concentrations of sodium proteinate in comparison to the concentration of sodium chloride, the less complete will be the equalisation of the concentrations of NaCl in the surrounding solution and the osmometer, and the more it is retained in the surrounding liquid. Let us give some figures illustrating the membrane equilibria of Donnan.

TABLE I.

Initial concentrations		Final concentrations NaCl	
NaR	NaCl	Inner solution	Outer solution
0·01	1	0·497	0·503
0·1	1	0·476	0·524
1·0	1	0·33	0·66
10	1	0·083	0·917
100	1	0·01	0·99

These figures show that the large amount of sodium proteinate makes the membrane appear as if impermeable to NaCl and this salt ceases to penetrate into the sac of the osmometer.

If a salt with another cation than the one connected with the proteinate within the osmometer is taken, for instance KCl instead of NaCl, another correlation will be obtained. As before this can be represented diagrammatically.

Initial State.

Na^+	R^-	|	K^+	Cl^-
C_1	C_1	|	C_2	C_2

Final State.

Na^+	K^+	Cl^-	R^-	|	K^+	Na^+	Cl^-
$C_1 - Z$	X	Y	C_1	|	$C_2 - X$	Z	$C_2 - Y$

The concentration X, Y and Z are connected by the equation $Z = X - Y$. Further, the conditions of equilibrium give us the following equations :—

$$\frac{C_1 - (x - y)}{x - y} = \frac{x}{C_2 - x} \quad \ldots \quad \ldots \quad (a)$$

$$\frac{C_1 - (x - y)}{x - y} = \frac{C_2 - y}{y} \quad \ldots \quad \ldots \quad (b)$$

hence $$\frac{x}{C_2 - x} = \frac{C_2 - y}{y}$$

or $$x + y = C_2$$

substituting in a and b we get

$$x = \frac{(C_1 + C_2)\,C_2}{C_1 + 2C_2}$$

$$y = \frac{C_2^{\,2}}{C_1 + 2C_2}$$

or $$\frac{(Na^+)_1}{(Na^+)_2} = \frac{(K^+)_1}{(K^+)_2} = \frac{(Cl^-)_2}{(Cl^-)_1} = \frac{C_1 + C_2}{C_2}$$

The cations of this electrolyte KCl introduced into the surrounding solution, will be attracted towards the interior of the membrane by the anion of the protein. The anion on the contrary will be forced outwards. Donnan illustrates this relation by the following table :—

Table II.

Initial concentration		Final concentration					
		K		Na		Cl	
NaR	KCl	Inside	Outside	Inside	Outside	Inside	Outside
0·1	1	0·5	0·5	0·05	0·05	0·5	0·5
1·0	1	0·66	0·33	0·66	0·33	0·33	0·66
10	1	0·90	0·10	9·2	0·8	0·10	0·90
100	1	0·99	0·01	99·0	1·0	0·01	0·99

With the great abundance of the colloidal ions within the osmometer, if compared to

the concentration of salts in the surrounding liquid, for instance 100 : 1 in the last line of our table, the almost complete disappearance of K (99 per cent. of the original amount) from the surrounding medium and its accumulation within the osmometer may be observed. At the same time the almost complete expulsion of the Cl ion from the osmometer is observed, in spite of the fact that both ions pass readily through the membrane and enter into no chemical reactions within the osmometer.

In an analogous way may be explained the accumulation of different kinds of ions in the plant cells containing a considerable amount of protein substances which show the properties of ampholytes, that is, substances which act as weak acids and weak bases and therefore are able to induce the accumulation of cations as well as of anions. As the composition of the colloidal substances in the cells changes continually, quantitatively as well as qualitatively, the conditions of Donnan equilibria prove very complicated in them. The protoplasma being impermeable not only to the colloids but also to many electrolytes, for instance to organic acids, these combinations too may determine the conditions for the establishment of Donnan's equilibrium between the cell and the surrounding medium, and may promote the accumulation in the plant of many anions and cations in much higher concentrations than are found in the surrounding medium, for instance in the soil solution. At the present time, attempts are being made to reconstruct the whole theory as to the entrance of substances from the soil into the roots on the basis of the conditions discovered by Donnan. This necessitates, however, an extension of Donnan's simple theory, to non-ideal solutions.

The Exact Theory of Membrane Equilibrium.[6, 7, 23]

The theory of membrane equilibrium in its most general form was established by Gibbs. He showed that if a fluid mass be divided into two parts by a rigid diaphragm, permeable by some of the components but impermeable by others, the conditions that are necessary for equilibrium can be stated as follows. In the first place, the absolute temperature T′ in the fluid phase designated L′ must be the same as the temperature T″ in the phase L″ on the opposite side of the membrane. In the second place, the partial free energy or chemical potential of each one of the substances which are free to diffuse accross the membrane must be the same in both phases. The potentials and other properties of the substances designated S_1, S_2, $S_3 \cdots S_r$ are distinguished by subscripts as in formula 11.

$$\mu_1' = \mu_1'', \qquad \mu_2' = \mu_2'' \qquad \cdot\cdot (11)$$

where μ_1' = the chemical potential of the substance S_1 in the phase L′. Such equations, applicable to all substances that can diffuse across the membrane, give the criteria for an exact thermodynamical equilibrium.

In the case of membrane equilibrium the hydrostatic pressures P_1 and P_2 on the two sides of the membrane are not necessarily equal, the same is the case with the potentials of the substances which cannot pass through the membrane.

Gibbs' conditions for equilibrium have been expressed by Donnan and Guggenheim[6,7] in a form which is easily applicable to experimental investigation.

$$\mu_1 = \mu_1^*(T) + Pv_1^*(1 - \tfrac{1}{2}K_1P) + RT \log N_1 f_1 \quad (12)$$

where μ_1^* (T) = a constant at a constant temperature, which need not be determined. P = the pressure in the solution. v_1^* = the volume occupied by 1 mol. of S_1 in a very dilute solution at zero pressure. K_1 = the compressibility of S_1 in very dilute solutions. (The equation 12 is subject to a small correction for the effects of changes in compressibility at very high pressures.) R = the gas constant. T = the absolute temperature. N_1 = molar fraction = mols. of S_1 divided by the total number of mols. in the solution. f_1 = the activity coefficient which may be a measure of the deviations from the ideal solution laws. The symbol f_1 denotes the activity coefficient at pressure P and f'_1 at pressure P′.

Donnan and Guggenheim obtained the equation 13 from 11 and 12, eliminating the constant term μ_1^* (T) which must be the same in both phases.

$$P'v_1^*(1 - \tfrac{1}{2}K_1P') + RT \log N_1'f_1' =$$
$$RT \log N_1''f_1'' + P''v_1^*(1 - \tfrac{1}{2}K_1 P''). \quad (13)$$

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[23] G. S. Adair, *Trans. Farad. Soc.*, 1937, **33**, 1106.

They suggested an abbreviated notation in which $[v_1]$ represents

$$v_1^* \, [1 - \tfrac{1}{4}K_1 \, (P' + P'')]$$

the volume at the mean pressure $\frac{P' + P''}{2}$.

In order to allow for the changes in compressibility with increasing pressure, the symbol $[v_1]$ is here defined by the formula

$$[v_1] = \left(\int v_1 \, dP\right) / \, (P' - P'') \quad .. \quad (14)$$

where v_1 denotes the volume occupied by 1 mol. of S_1 in a very dilute solution. With this definition the equations 15 to 21 are exact.

$$(P' - P'') \, [v_1] + RT \log N'_1 f'_1 = RT \log N_1'' f_1'' \quad .. \quad (15)$$

If the substance S_1 be solvent water, it may be more convenient to use osmotic coefficients g_1' and g_1'' as a measure of the deviations from the ideal solution laws.

$$(P' - P'') \, [v_1] + g_1' \, RT \log N_1' = g_1'' \, RT \log N''_1 \quad .. \quad (16)$$

Equations like 13 and 15 can be applied to any non-electrolyte that can diffuse across the membrane.

$$(P' - P'') \, [v_2] + RT \log N_2' f_2' = RT \log N_2'' f_2'' \quad .. \quad (17)$$

If we eliminate the pressures, using equations 15 and 17 we obtain the equation 18 given by Donnan and Guggenheim.

$$\frac{(N_2' f_2')}{(N_1' f_1')^r} = \frac{(N_2'' f_2'')}{(N_1'' f_1'')^r} \quad .. \quad .. \quad (18)$$

where $r = [v_2] \, / \, [v_1]$.

A slight modification of their treatment with special reference to systems in which the pressures can be determined with greater accuracy than the molar fractions is given by Adair.[23] With the abbreviation

$$h_1 = [v_1] \, (P' - P'') \, / \, RT \quad .. \quad (19)$$

the equation 15 may be restated in the form

$$N_1' f_1' e^{h_1} = N_1'' f_1''$$

where $e^{h_1} = 1 + h_1 + \tfrac{1}{2} h_1^2 + \cdots \quad (20)$

A similar formula can be applied to the substance S_2 and in a system where S_1 and S_2 can diffuse across the membrane we get

$$\frac{N_2' \, f_2' \, e^{h_2}}{N_1' \, f_1' \, e^{h_1}} = \frac{N_2'' \, f_2''}{N_1'' \, f_1''} \quad .. \quad .. \quad (21)$$

In practical applications of the theory of membrane equilibrium it is customary to use a simpler, but approximate formula

$$m_2' f_2' = m_2'' f_2'' \quad .. \quad (22)$$

where m_2 = the molality in aqueous solutions expressed in gram-mols of S_2 per 1000 grams water. The estimation of the errors due to the use of the approximate formula has been made by Adair, and his calculations show that although the error in investigations of the membrane equilibria, of small molecules, in systems where the pressure difference $P' - P''$ is small, can be disregarded, the exact formula will have to be used in the interpretation of experiments with membranes permeable by large molecules as, for example, in the ultrafiltration of proteins described by Elford,[24] and the work of Moran[25] on equilibria with gelatine gels and sodium chloride at pressures exceeding 2000 atmospheres.

The Membrane-Equilibrium of Ionised Electrolytes.

In a system where an acid, a base for a salt can diffuse across the membrane, the chemical potential of the electrolyte must be the same in both phases as stated in 11. If the electrolyte dissociates, yielding r_i ions of the species S_i and r_j ions of the species S_j, the diffusion of an ion is subject to the condition that an equivalent quantity of ions of opposite sign pass across the membrane in the same direction. The condition for equilibrium is

$$r_i \, \mu_i' + r_j \, \mu_j' = r_i \, \mu_i'' + r_j \, \mu_j'' \quad .. \quad (23)$$

we can compare this with $(Na^+)_1 \times (Cl^-)_1 = (Na^+)_2 \times (Cl^-)_2$ given by Donnan.

In a system where two ions of the same sign, S_i and S_k can diffuse across the membrane, we get the equation 24, since the possible variations dm_i' and dm_k' in the composition of the phase L′ are subject to the condition that

$$dm_i' \, / \, n_i = - \, dm_k' \, / \, n_k$$

$$\frac{\mu_i'}{n_i} - \frac{\mu_k'}{n_k} = \frac{\mu_i''}{n_i} - \frac{\mu_k''}{n_k} \quad .. \quad .. \quad (24)$$

or $\quad (\mu_i' - \mu_i'') n_k = (\mu_k' - \mu_k'') n_i \quad .. \quad (25)$

In a system where two salts containing the ions S_i, S_j and S_k can diffuse across the membrane, equations 23 and 24 are both applicable, it is possible to restate these formulæ in terms of molar fractions, as in formula 19

$$(N_i' \, f_i' \, e^{h_i})^{r_i} \, (N_j' \, f_j' \, e^{h_j})^{r_j} = (N_i'' \, f_i'')^{r_i} \, (N_j'' \, f_j'')^{r_j} \quad .. \quad (26)$$

[24] Elford, *ibid.*, 1937, **33**, 1100.

[25] Moran, *Report of Food Investigation Board for* 1935, 20.

The activity coefficients of the individual ions can be replaced by $f\pm$, the mean activity coefficient. If the pressure difference $P' - P''$ be small, and f the activity coefficient of water be the same in both phases, we get the equation 27, which is applicable to a salt with two univalent ions

$$\frac{(f\pm')^2}{(f\pm'')^2} = \frac{m_{Na}'' \times m_{cl}''}{m_{Na}' \times m_{cl}'} \quad \ldots \quad \ldots \quad (27)$$

It appears that equation 27 is useful in considerations of the state of equilibrium between the blood and the aqueous humour discussed by Ridley[26] and by Davson, Duke-Elder and Benham.[27]

If the osmotic pressure be low and both of the ions be univalent, equation 27 is replaced by the simple but approximate equation 28.

$$\frac{m_i' \; f_i'}{m_k' \; f_k'} = \frac{m_i'' \; f_i''}{m_k'' \; f_k''} \quad \ldots \quad \ldots \quad \ldots \quad (28)$$

Membrane Potentials and the Potentials of Individual Ions.

From the thermodynamical point of view, no criterion for the equilibrium of an individual ion across the membrane is necessary because the possible variations in the state of the system are comprehended by equations 23 and 24 applicable to pairs of ions. Under certain conditions, it is, however, convenient to supplement these equations by another equation involving the potentials of the ion S_i in both phases L′ and L″ and the electrical potential difference $(E' - E'')$ between the phases.

$$\mu_i' = \mu_i'' - n_i \, F \, (E' - E'') = \mu_i'' - n_i' \; FE \quad (29)$$

F = Faraday's equivalent in volt-coulombs. $E = E' - E''$, n_i the valence of the ion of the species S_i is negative for anions. This formula is comparable with the approximate formula

$$pH' = pH'' - \frac{E}{0 \cdot 05416} \times \frac{273}{273 + t} \ldots \quad (30)$$

used by Loeb[28] and by Adair and Adair.[29] The last mentioned authors correlate the membrane potentials and pH values, they also give a precise method for the measurement of membrane potentials with certain types of solutions containing proteins.

Membrane Equilibrium in Systems where the Composition of one Phase is Constant.

In studies on proteins, it is often desirable to investigate solutions containing a mixture of inorganic electrolytes. If the protein solution L′ be enclosed in a membrane permeable by all the components except the protein, in equilibrium with the dialysate L″ of constant temperature, pressure and composition, the properties of the system are determined by one independent variable, the concentration of the protein in L′, even if the number of diffusible substances be unlimited. Adair[30, 31] has shown that the potential of the protein, or the protein salt μ_{ps} is correlated with the observed osmotic pressure π and the volume V of solution per mol. of protein by the formula

$$d \, \mu_{ps} = V \, d\pi \quad \ldots \quad (31)$$

Some special cases of this type of equilibria have been considered by Adair. For example, he gives the relationship between osmotic pressures, protein concentrations, molecular weights of hæmoglobin[32, 33] and serum proteins in systems where L′ is constant and also the effects of proteins[34] on the activity coefficients of diffusible ions.[29, 32, 34, 35] Adair[32, 34] also suggested a method for extending the theory to ideal systems with low osmotic pressures, including colloidal solutions in mixed solvents, in which the composition of the solution L′ is expressed in 'corrected concentrations' in gram mols. per litre of the mixed solvent.

$$[S]_c' = [S]_0' \times 100/(100 - V_1 \, C) \quad (32)$$

$[S]_c'$ = corrected concentration of substance S in L′.

$[S]_0'$ = observed concentration in mols. per litre of solution.

C = grm. colloid per 100 c.c. solution.

V_1 = volume occupied by 1 grm. colloid, including water of hydration.

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[26] Ridley, *Brit. Journ. Exp. Path.*, 1930, **11**, 217.

[27] Davson, Duke-Elder and Benham, *Biochem. Journ.*, 1936, **30**, 773.

[28] Loeb, *Proteins and the Theory of Colloidal Behaviour*, New York, 1922.

[29] Adair and Adair, *Biochem. Journ.*, 1934, **28**, 199.

[30] Adair, *Journ. Amer. Chem. Soc.*, 1929, **51**, 696.

[31] Adair, *Trans. Farad. Soc.*, 1935, **31**, 98.

[32] Adair, *Proc. Roy. Soc.*, 1928, A, **120**, 573.

[33] Adair, *Proc. Camb. Phil. Soc.* (*Biol.*), 1924, **1**, 75.

[34] Adair and Robinson, *Biochem. Journ.*, 1930, **24**, 1864.

[35] Adair and Adair, *ibid.*, 1934, **28**, 1230.

The theory of membrane equilibrium may be applied to the process of dialysis, because the rate of removal of a diffusible impurity S_n from a colloidal solution L′, enclosed in a membrane surrounded by pure water is partly determined by the distribution ratio $r_n = [S_n]_c' / [S_n]_c''$

$$-\frac{d}{dt}[S_n]_c' = [S_n]_c'\left(\frac{1}{r_n}\right)k_n \qquad .. \quad (33)$$

where t = time, k_n is a coefficient, directly proportional to the area of the membrane, and inversely proportional to the volume of the solution L′ and the thickness of the membrane. k_n is an undetermined function of the shape of the membrane, the rate of stirring and other factors. On the assumption that k_n is a constant, the reciprocal of the distribution ratio, is a measure of the rate of dialysis. Adair's[23] work shows that the effect of salts on the rate of removal of impurities is of importance in studies on systems where the composition of the dialysate is *constant*.

Before we proceed to describe the applications of this theory of membrane equilibrium, it may be pointed out that the presence of a membrane is not absolutely necessary for the existence of the Donnan equilibrium. The theory is applicable to any system which contains some kind of ions, which are not allowed to diffuse to some part of the system. The diffusion of the ions may be hindered either by the formation of aggregates round the ion, or by the absorption of the ion on the surface of the membrane, or some other peculiar property of the ion. For all practical purposes we can assume that the theory of Donnan is applicable even when the ion is able to diffuse, but the rate of diffusion is very small.

OBITUARY.

Sir Nowroji Saklatvala, C.I.E., Kt., K.B.E.

INDIA, the Parsee community and particularly, the House of Tata, incurred last July a grave loss in the death of Sir Nowroji Saklatvala, less than one month after the untimely death of Mr. J. A. D. Naoroji.

Born on September 10, 1875, a nephew of the famous industrialist Mr. J. N. Tata, Nowroji Bapuji Saklatvala was naturally destined for association with Messrs. Tata Sons, Ltd., and this began in 1889 as a cotton-mill apprentice. Rapid promotion was earned by whole-hearted application to work, linked with aptitude, these qualities being recognised outside the firm by his appointment in 1916 to Chairmanship of the Bombay Millowners' Association, which he represented in the Legislative Assembly six years later. Increasing knowledge of the varied interests embraced by the firm, fortified by devoted loyalty thereto, made it appropriate that he should become Chairman at the death of Sir Dorabji Tata in 1932, in which year he was appointed also Chairman of the Tata Iron and Steel Co., Ltd. Thence forward he maintained a detailed interest in the vast Jamshedpur corporation, meriting the gratitude of the employees by addressing himself to an improvement of their conditions and pay through a profit-sharing scheme.

In spite of these heavy responsibilities, Sir Nowroji found time to associate himself with other commercial enterprises including insurance and banking, whilst identifying himself with a recently successful fusion of the various conflicting cement interests. As Chairman of the Sir Dorabji Tata Trust, he guided the disposal of princely charitable funds with vision and wisdom, lately approving the construction of a Cancer Institute. The human side of his character was illustrated by his early work for the Cricket Club of India, and by his uniform encouragement of all social clubs attached to the numerous industrial corporations with which he was connected.

Testimony of employees and business associates alike shows that Sir Nowroji commanded their respect and affection by his integrity and sympathy. Government recognition of his valuable services to Indian industry came with C.I.E. (1923), a Knighthood (1933), and the K.B.E. (1937). Although nominally on holiday at the time of his death he was actually engaged in a business visit to the United States, England and Scandinavia, and was resting at Aix-les-Bains when he died suddenly on July 21, within a few weeks of completing his sixty-third year.

LETTERS TO THE EDITOR.

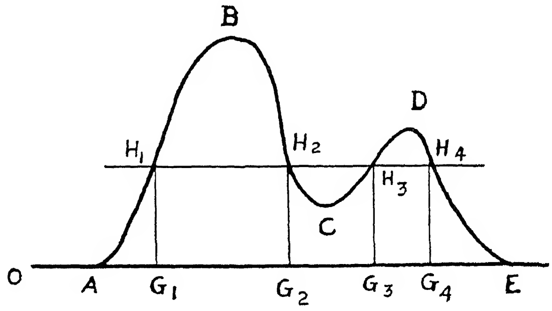
The Fundamental Idea underlying Statistical Tests of Significance.

Suppose an individual has been drawn at random from a known population, but that we are not sure of this. To see whether he could possibly have been drawn from this population we apply a test of significance. This test consists solely in dividing the whole population into two classes A_1 and A_2, such that the number of individuals in A_1 bears to the number in the whole population an arbitrary ratio, P, called the limit for random chance or the limit of significance. If our individual falls in the class A_1, he is not considered significant.

Obviously, this division can be affected in an infinite number of ways; we will have thus an infinite number of tests of significance applicable to the same case. From the point of view of success in the long run each of these tests is as good as any other, provided the same test is used on every relevant occasion. From the practical point of view, however, these tests are not equal and the best test is that based on what may be called the "fundamental idea". Since in a significance test some individuals have to be neglected, the fundamental idea states that the least harm is done by neglecting the least frequent individuals.

We will apply this idea to the following slightly complex case. Suppose the frequency curve is A B C D E, the distinguishing character of the individual being measured along O E.

We now draw $H_1\ H_4$ parallel to OE so that areas $A\,H_1G_1 + G_2H_2CH_3G_3 + G_4H_4E$ divided by the total area A B C D E is equal to P, our limit for random chance.



Then the class A_1 consists of individuals represented by the intervals AG_1, G_2G_3 and G_4 E. H_1G_1, $H_2G_2, \cdots$ are ordinates through H_1, $H_2, \cdots$.

It is easy to see that only one test of significance follows from this idea. Although the idea is very simple, it does not appear to be well known. In support of this view it may be stated that Clopper and Pearson in their paper[1] have suggested a test of significance in which an area equal to P/2 is cut off at each tail end of a binomial distribution. Again, when Rhodes suggested in the paper[2] two different tests for the same case, Karl Pearson remarked (page 252)[2] "we can test whether two samples are consubstantial in a variety of ways, is it possible to find a better test—by which I mean a more stringent test—than the 'classic method' of examining the distribution of difference?" If the fundamental idea had been used, this difficulty would not have arisen.

More details will be given in a paper to be sent for publication elsewhere.

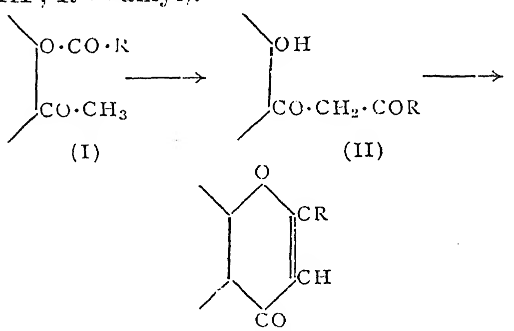
S. R. Savur.

Poona, 5.
September 1, 1938.

[1] Clopper, C. J., and Pearson, E. S., *Biom.*, 1934, **26,** 404–13.
[2] Rhodes, E. C., *ibid.*, **16,** 239–48.

Preparation of Flavones from *o*-Aroyloxyacetophenones.

Baker[1] showed that *o*-aroyloxyacetophenones (I) rearrange with anhydrous potassium carbonate in presence of benzene or toluene into the corresponding *o*-hydroxydibenzoylmethanes (II) from which flavones (III; R = aryl) may readily be obtained by elimination of water. Mahal and Venkataraman[2] and Bhalla, Mahal and Venkataraman[3] used sodamide in dry ether. It has now been found that satisfactory results can be obtained with finely-divided sodium in ether or toluene; sodamide and sodium have the advantage that no water is liberated when the product, the metallic salt of the dibenzoylmethane, is formed. A number of flavones have thus been prepared by the use of sodium, and the method is being applied with advantage in the synthesis of 2-naphthylchromones (III; R = $C_{10}H_7$) of various types. It has been here found that sodium also produces rearrangement of *o*-acyloxyacetophenones thus providing a synthesis of 2-alkylchromones (III; R = alkyl).



(I) (II) (III)

V. V. Virkar.
T. S. Wheeler.

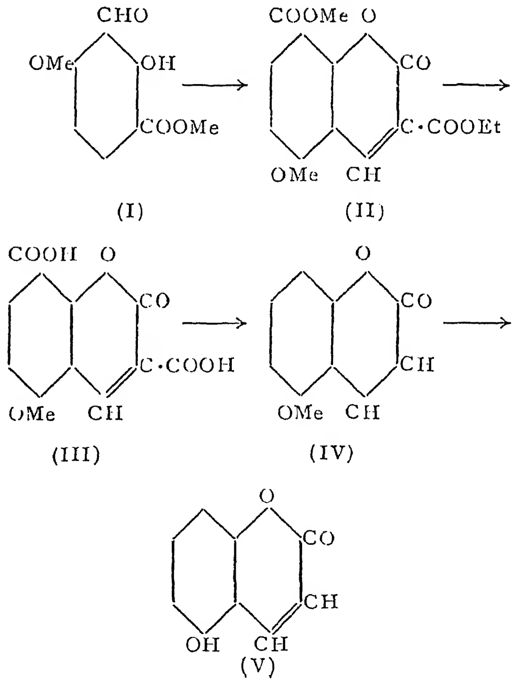
Royal Institute of Science,
Bombay,
September 3, 1938.

[1] *J.C.S.*, 1933, 1381; 1934, 1953.
[2] *Curr. Sci.*, 1933, **2,** 214; *J.C.S.*, 1934, 1767.
[3] *J.C.S.*, 1935, 868.

Synthesis of 5-Hydroxy Coumarin.

5-Hydroxy-4-methyl coumarins which have been difficultly accessible until recently are now readily available through the condensation of methyl-β-resorcylate and resacetophenone with ethyl acetoacetate in presence of anhydrous $AlCl_3$.[1] The method however cannot be obviously applied for the synthesis of the simple 5-hydroxy coumarin which is hitherto unknown. After some unsuccessful attempts this interesting compound has now been synthesised starting with methyl-β-resorcylate.

The 5-hydroxy coumarin was synthesised as follows:—Methyl 2 : 4-dihydroxy-3-formyl benzoate[2] was methylated to methyl 2-hydroxy-3-formyl-4-methoxy benzoate (I) which on condensation with ethyl malonate afforded ethyl 5-methoxy 8-carbmethoxy coumarin-3-carboxylate (II), m.p. 186–88°. This was hydrolysed to 5-methoxy coumarin-3-8-dicarboxylic acid (III, m.p. 281°) which on decarboxylation afforded the 5-methoxy coumarin (IV, m.p. 85–87°). The 5-methoxy coumarin on demethylation yielded the 5-hydroxy coumarin (V, m.p. 221–23°). The 5-methoxy coumarin afforded the 2,6-dimethoxy cinnamic acid (m.p. 151–53°).



(I) (II) (III) (IV) (V)

A detailed account of the above investigation will shortly be published elsewhere.

H. A. SHAH.
R. C. SHAH.

Royal Institute of Science,
Bombay, &
Ismail College, Andheri,
Bombay,
August 6, 1938.

[1] Sethna, Shah and Shah, *J.*, 1938, 228.
[2] Shah and Laiwalla, *Curr. Sci.*, 1936, 197.

Polyploid Plants produced by Colchicine and Acenaphthene.

BY treating germinating seeds of various *Nicotiana* species and hybrids in 0·5 per cent. aqueous solution of colchicine for 20, 40 and 72 hours, deformed seedlings were raised, from which normal and slightly abnormal diploid and polyploid plants of the following species and species hybrids developed: *N. rustica* (in several varieties including the best variety "Khmelevka"), *N. Sanderæ*, *N. glauca*, F_1 hybrids *N. alata-Sanderæ*, F_1 hybrids *N. suaveolens* × *alata*, F_1 hybrids *N. excelsior* × *velutina*, F_1 hybrids between two varieties of *N. suaveolens*, etc. In all these species and hybrids, plants with doubled chromosome numbers were obtained, while in the hybrid *N. alata-Sanderæ*, octaploids were also produced. Sterile hybrids were rendered fertile by chromosome doubling. Tetraploid plants were also obtained in *Phlox* after colchicine treatment.

Treating germinating seeds of Salat (*Lactuca sativa*) with crystals of acenaphthene for six days, I obtained deformed seedlings from which vigorous plants developed. The control plants reached a size of $\frac{2}{3}$ to $\frac{3}{4}$ of the size of treated plants. In other words, acenaphthene has a very high stimulating activity. Among the treated plants with acenaphthene, I found one tetraploid. The latter plant began to flower about ten days later than the diploid treated plants, *i.e.*, it had a much longer vegetation period. This is a profitable character from the agricultural point of view.

Reagent tubes were covered from inside with crystals of acenaphthene. Shoots of various *Nicotiana* species were covered with such tubes and closed from downside with cotton and then left for several days (2–10). Some of the new branches formed from the treated shoots were polyploid. I found in *Nicotiana longiflora*, for example, tetraploid

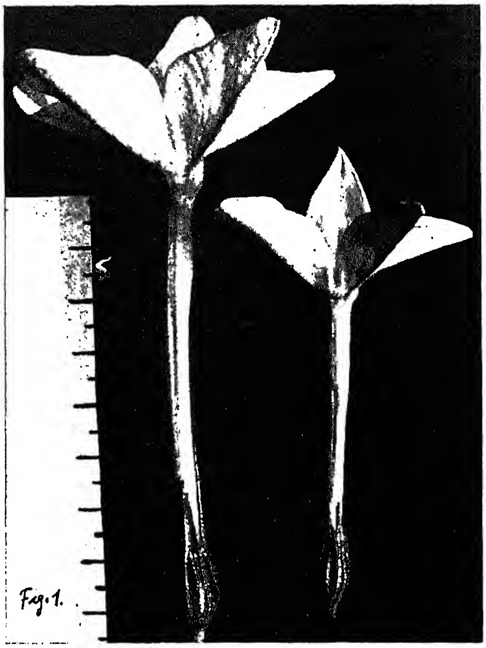


FIG. 1.

Flowers from tetraploid (left) and diploid (right) *N. alata* types.

FIG. 2.

Flowers from left to right: (1) from a tetraploid plant; (2) from a diploid plant of *N. suaveolens* varietal cross; (3) from a tetraploid *N. rustica*; and (4) from a diploid *N. rustica*.

and octaploid shoots. The chromosome numbers in the plants treated with acenaphthene and colchicine were determined in the pollen-mother cells.

Each polyploid plant produced in these experiments had longer vegetation period,

thicker and broader leaves, larger pollen and stomata board cells, larger floral buds, broader corolla tubes, larger trichomes, darker green colour, larger ovules, larger seeds and coarser appearance than the

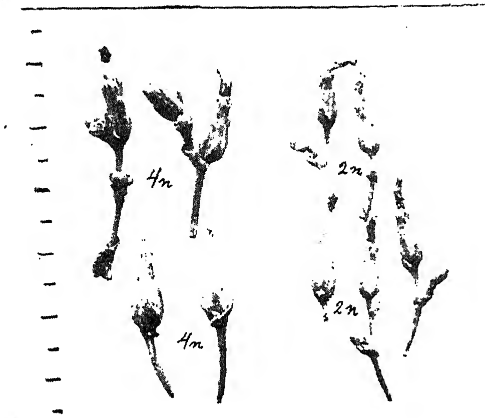


FIG. 3.

Lactuca sativa—left tetraploid, right diploid.

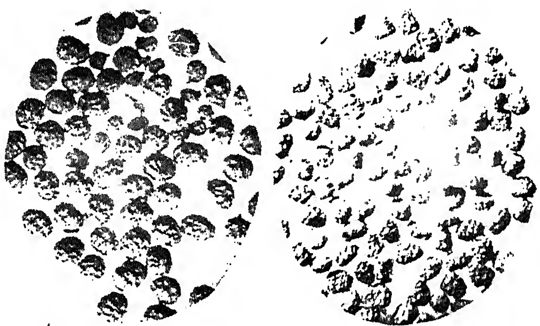


FIG. 4.

Seeds from polyploid *N. longiflora* (left) and from diploid form (right).

diploid ones. Some polyploid plants had much longer flowers, while others had shorter ones as compared with the diploid plants. There were also tetraploid plants in which the flowers were about as long as in the diploid ones.

Discs with equal diameters were cut out of the leaves about 1 cm. below the apex from diploid, tetraploid, and octaploid plants and were weighed. Discs of tetraploid plants were about 30 per cent. heavier than those of the diploids, while those of the octaploids were about 30 per cent. heavier than those of the tetraploids and about 60 per cent. heavier than the discs of the diploids.

The characters.—Weight of the leaves, size of the seeds, length of the vegetation period, size of the flowers, fertility (rendering

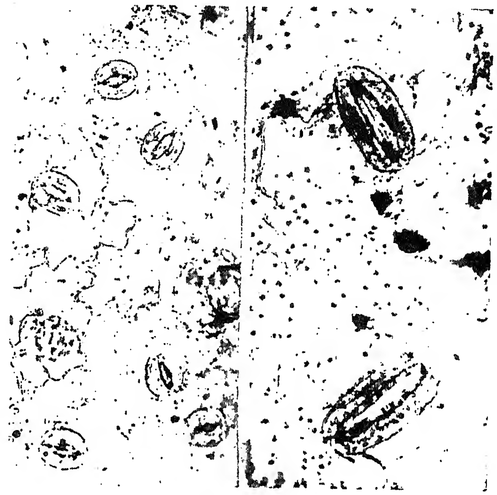


FIG 5.

Stomata board cells of diploid (left) and octaploid *N. alata-Sanderae* plants.

sterile hybrids fertile and fertile species into partially fertile by chromosome doubling), etc., being affected by chromosome duplication, are of great significance for the plant breeders, especially for the horticulturists.

It is worth while mentioning the following two factors affecting fertility in the autopolyploids: (1) chromosome length and (2) chromosome number. Auto-octoploid *Triticum durum*, for example, obtained by acenaphthene treatment formed multivalent chromosomes during the meiosis of a higher range and was self-sterile, while most of the tobacco species having shorter chromosomes than *T. durum*, formed less multivalents, had more regular meiosis, and their fertility was less affected. Tetraploid *N. rustica*, having 96 chromosomes formed rarely multivalent chromosomes, but it had irregular meiosis, probably because of a too great crowding of the chromosomes, especially during the second meiosis. This seems to bear a causal connection with the non-significant increase of the distance between the nucleus and the cell wall. On the basis of these observations one might conclude that fertility of autotetraploids will be less

affected in plants, having shorter chromosomes and small chromosome numbers.

DONTCHO KOSTOFF.

Institute of Genetics,
Academy of Sciences of USSR,
Moscow,
July 31, 1938.

Minimum Adequate Size of Sample of F_2 required in Experiments on Hybrid Vigour and Inheritance of Quantitative Characters.

IT has been pointed out that the most unsatisfactory feature in hybrid vigour experiments has been the inadequacy of numerical data. Examples of inadequate data are not rare, probably the most outstanding is that of Kadam[1] who based his conclusions on a population of 2, 3 and 4 plants. One of the outstanding reasons for this is the difficulty of obtaining sufficient number of F_1 seeds. Efforts have always been made by workers to compare an F_1 generation directly with the parents and subsequent filial generations. The difficulty of comparing parents with an F_1 generation and not relying on the subsequent generations has compelled them to limit their trials to only small experiments. There are two reasons for not relying upon F_2 and subsequent generations. First is that, in these generations, segregation of genes takes place and therefore, it becomes difficult to observe clearly the manifestation of hybrid vigour; second reason is that because it is almost impossible to use all the F_2 seeds in trials, there is every likelihood of taking a sample of such combinations which may show more or less vigour than the whole population. It is mainly for these reasons that hybrid vigour experiments have not been usually conducted on modern system of field trials, *e.g.*, in randomised blocks and latin squares. Engledow and Pal[2] and Pal *et al*[3] seem to be the only workers who conducted hybrid vigour experiments on wheat in latin squares and randomised blocks so that the data could be subjected to statistical analysis.

Similarly, review of literature shows that for studying the inheritance of quantitative characters, workers have been using, very wide ranged F_2 populations. For instance Nohara[4] based his conclusions on an F_2 population of 24. Whereas Ramiah[5] used as many as 2466. Another worker working on cotton concluded that a certain character was governed by four pairs of factors, the F_2 population on which he based his conclusions was even less than 256 plants which is the least number for getting all the genotypes. Similarly East[6] studied height character in tobacco on an F_2 population of 114 plants, while Howard[7] did the same on 647, 356 and 331 plants in case of different tobacco crosses.

It is evident that there has not been any standardisation of taking F_2 populations for studying the inheritance of quantitative characters. Of course, there is not much harm in taking larger populations but it is quite obvious that there are very few chances to arrive at valid conclusions from such meagre populations as 2, 24 or 114 plants.

The purpose of this paper is to determine:

(1) How far it is admissible to compare F_2 with parents and F_1 in randomised blocks and latin squares in hybrid vigour experiments.

(2) What should be the least adequate size of sample in F_2 for studying the inheritance of quantitative characters? Both these problems do not seem to have hitherto received the attention of the workers. These will be dealt with separately under two different headings, namely, hybrid vigour and inheritance of quantitative characters.

I. Hybrid Vigour.—According to Mendelian laws of inheritance if the difference between two characters is governed by three pairs of factors, a population of at least sixty-four is required to have all the genotypes in F_2. Similarly for four pairs of factors 256, for five 1024 and for six 4096. To compare F_2 against parents and F_1 in randomised blocks and latin squares it will be necessary to grow in each block a population of 4096 in case of six pairs of factors or at least such a representative sample average of which may not differ from that of 4096 plants. When looking into this aspect of the problem the following questions are apt to arise:—

(1) Whether the total F_2 population raised from F_1 is the same or is at least representative of the expected F_2 population.

(2) If the total F_2 population is the same as the expected F_2 or is representative of that, what should be the minimum adequate size of the sample which may be obtained

from that very population so that it may be represented.

(3) Whether the size of the sample determined for any character will be adequate in case of all the characters to be studied in that cross.

(4) Whether the size of the sample and of population determined for any one character will be adequate for that very character in whatever cross and wherever it may be studied.

To solve the above mentioned questions, if different sized samples are obtained from a population and such samples are secured, the means of which do not differ from each other statistically and also lie within the limits of the general mean ± twice its standard error, it will be concluded that such samples will be representative of the whole population. If from a certain population such adequate samples cannot be obtained, that population may not necessarily be sufficient and it may not represent the expected or actual F_2 population. Thus the representativeness or otherwise of a population or a sample can easily be determined for different characters.

It is obvious that if F_2 population raised from an F_1 generation is not the same or representative of the expected F_2 population, it is erroneous to grow the whole of the population as in lots or small inadequate samples. In both the cases the validity of the conclusions will be affected. If the population for certain character is proved to be quite adequate appropriate minimum size of a sample shall have to be determined for that character as explained above. Both adequate populations as well as samples shall have to be determined for all the characters in case of different crosses. Should 200 be the adequate minimum size of sample for height in a paddy cross, a population of at least 1,200 will be required for six replicates in randomised blocks and 800 for a latin square of four columns and four rows. Growing of less than 200 plants in any block, row or column will not be permissible.

From published data in case of about half a dozen crops, both size of population as well as of sample were determined. It was seen that in most cases the adequate size of sample ranged between 200 and 300. But, however, there were cases where even a sample of 500 did not prove to be representative, and in some cases the population was so small that a representative sample could not be determined, *e.g.*, from East (*loc. cit.*) data of 114 plants, Howard (*loc. cit.*) data of 100 plants and Shaw and Bose[8] data of 300 spikelets. However, it is a matter of detail and will take time to standardise the size of population as well as of sample for different crosses.

In view of what has been said above it is concluded that comparison of F_2 with parents and F_1 in randomised blocks or latin squares will only be admissible if in each block, row or column such a sample is grown as may either be the same as the expected F_2 population or a representative of it.

II. *Inheritance of Quantitative Characters.*—Importance of study of inheritance of quantitative characters hardly needs any emphasis. Much work has been done in this line in case of all the farm crops. The workers on this subject, as mentioned before, have been using very wide ranged F_2 populations, *e.g.*, 24–2,466 or more. There can hardly be any justification for basing conclusions, such as, that a certain difference between two characters is governed by four pairs of factors, on a meagre population of twenty-four plants. A population which is neither the same as the expected F_2 nor is representative of that, cannot be relied upon for such a study.

As already explained under hybrid vigour there seems to be a necessity for determining the adequate size of a sample for each and every character for all the crosses. In such a study as inheritance of quantitative characters there is no harm in taking as large a sample as possible, but in no case less than the adequate size of sample determined for a certain character is permissible. Validity of the conclusion based on a population which may not be reperesentative of the expected F_2 population, is subject to a great deal of criticism.

CH. NEK ALAM.
Department of Agriculture,
Gurdaspur,
June 22, 1938.

1 Kadam, Patil and Patankar, *Ind. J. Agric. Sci.*, 1937, **7**, 118.
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3 Pal and Alam, *J. Ind. Sci. of Acad.*, 1938, **7**, **3**, 109–24.
4 Nohara, *J. Coll. Agri. Tokyo*, 1933, **12**.
5 Ramiah and Parthasarathi, *Ind. J. Agric. Sci.*, 1933, **3**, 808.
6 East, *J. Gen.*, 1916, **1**, 164.
7 Howard, *Mem. Dept. Agric. Ind.* (*Bot. Ser.*), 1913, **6**, 52, **3**, 89.
8 Shaw and Bose, *ibid.*, 1933, **3**, 771–807.

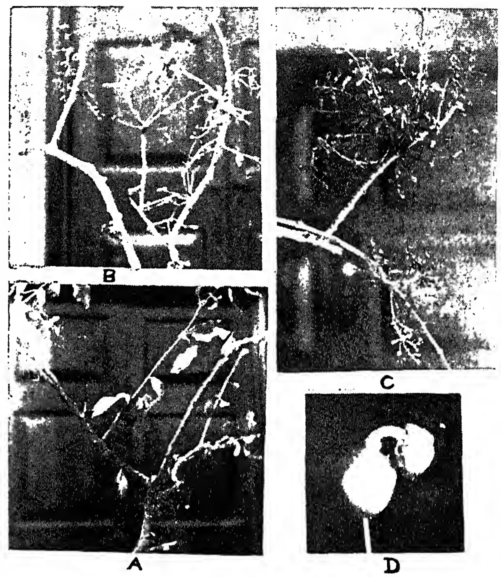
A Case of Triple Parasitism? *Loranthus* vs. *Viscum* vs. *Viscum.*

SPECIES of *Loranthus* and *Viscum* form the most common semi-parasites on many of the deciduous forest trees in the neighbourhood of Bangalore. The membres of Loranthaceæ come next to those of Santalaceæ, so far as the number of hosts they affect. They have also some common hosts (1923). It is very rarely that one comes across a *Loranthus* growing parasitic on another *Loranthus* or *Viscum* and *vice versa*. Brown (1918) reports a case of double parasitism of *Phoradendron californicus* on *Phoradendron flavescens* near Tucson. Morris (1922) records a case of *Loranthus exocarpic* growing on *Loranthus pendulus* and *Loranthus quandong.*

An interesting case of double parasitism was noticed in which *Loranthus longiflorus* Desv., acting both as a partial parasite and a host was found on *Shorea talura* Roxb. The host plant is grown extensively for the cultivation of lac. *Loranthus longiflorus* forms a serious pest on it, in some cases bringing down its vitality considerably. Practically every plant in the locality has been attacked by one or many parasites, which appear to be quite hardy. *Loranthus longiflorus* Desv. has been found to be attacked by a *Viscum* (Fig. A and B) *Viscum ramosissimus* Wall, which is quite unlike the common species of the locality, *viz.*, *Viscum orientale* (Fig. C). Thus the host-parasite relationship in this case was not between two Loranthi but between a *Loranthus* and a *Viscum* which is rather rare and appears to be the only instance on record. The water relations of these associations must be very complex and interesting as suggested by Harris and others (1930).

A further interesting stage in this relationship or association has been observed, where not only the *Loranthus longiflorus* Desv. acts both as a semi-parasite and a host but also the Viscum—*Viscum ramosissimus* Wall.

In its turn *Viscum ramosissimus* grows on Loranthus parasitically and at the same time it allows a number of its own seeds or those of other viscum plants to germinate on its body so that some of them at least might establish themselves as full-grown parasites. A curious example of this kind is the germination and growth of a Viscum seed on a just ripening fruit, evidently that of *Viscum ramosissimus* (Fig. D). The seed must have settled on this fruit when it was very young and has germinated and produced the disk by the time the fruit has matured.



A.—*Viscum ramosissimus* on *Loranthus longiflorus.*

B.—Several plants of *Viscum* growing on a single branch of *Loranthus.*

C.—Two clumps of *Viscum* to show the details of their habit.

D.—*Viscum ramosissimus* seed germinating and growing on a fruit of *Viscum ramosissimus.* × 5.

(Figs. A, B and C have been reduced while photographing.)

Can these instances be called Triple Parasitism? Anyhow, the host-parasite relationship of these associations becomes more complex.

L. NARAYANA RAO.

Central College,
Bangalore,
August 15, 1938.

1. Brown, J. G., *Bot. Gaz.*, 1918, **65**, 2, 193.

2. Harris, J. A., Harrisson, G. J., and Pascoe, T. A., *Ecology*, 1930, **11**, 687–702.

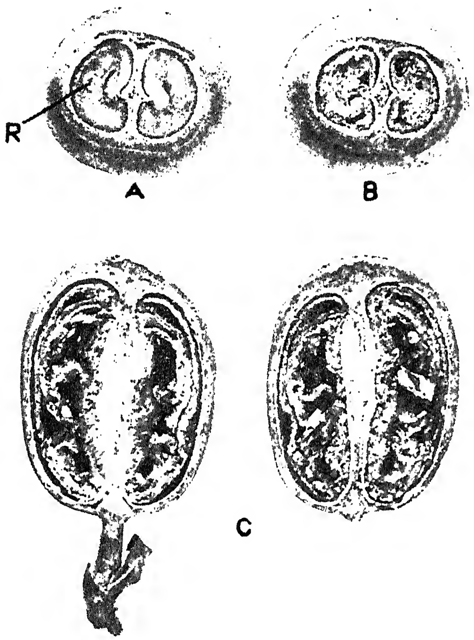
3. Jivanna Rao, P. S., *Indian Forester*, 1923, **49**, 416–28.

4. Morris, A., *Aust. For. Jour.*, 1922, **5**, 325.

Coffee Black Bean.

BLACK BEAN in Coffee (*Coffea arabica* Linn.) has been known for a long time. Reports and samples have been received from different coffee estates in the Mysore State during the years 1921 to 1928, but the losses have scarcely been heavy. Thomas[1] has mentioned black been in coffee. Mayne[2] has devoted a good deal of his time to this obscure disease during the years 1930–31 to 1937–38. He is of opinion that it is due to an abnormality of the inner silver-skin layer or nucellus.

Last year a bad case was reported from an estate near Kalasa in Kadur District. Investigations on the spot led to the interesting observation that black bean is associated with the absence of the embryo (see Fig. B).



A.—A healthy fruit of *Coffea arabica* Linn. in cross-section. R, is the radicle of the embryo.

B.—A black bean fruit of *C. arabica* in cross-section at same level as *A.* Note absence of embryo and disintegration of the endosperm.

C.—Another black bean fruit of *C. arabica* in longitudinal section.

Black bean fruits develop on the plant just like the other fruits, and may sometimes be detected by feeling them. They appear not as full as healthy fruits and feel very much like wilted fruits due to loss of turgor. The affected fruits do not drop down but remain on the plant till the other fruits mature. When an affected fruit is cut the bean is found to be black inside. This condition may be present in only one bean or in both beans of such a fruit. Even the single bean of the peaberry may be black. The endosperm is collapsed. Sometimes the affected beans do not turn black, but are only shrivelled. The blackening is probably only a change that takes place in the endosperm due to the non-development of the embryo. The black bean is very light, the parchment being intact, and comes up in the pulping vat as floaters or skimmings.

The possibility is that pollination or fertilization has not taken place. Sterility in coffee has been known to occur.[3] Due to the absence of pollen or due to its incompatibility, the fruit may develop parthenogenetically. A great deal of hybridization work has been going on in coffee during recent years, and a large number of varieties and species have been introduced for this purpose. Side by side natural hybridization has perhaps taken place. Hybridization has been known to lead to parthenogenesis,[4] and it is possible that many of the coffee plants, which might be only natural hybrids, develop some of their fruits parthenogenetically. Feng[5] has found in the seeds of Asiatic-American hybrids of cotton a very small embryo or none at all, even though they possessed well-developed seed-coats. "The ovules of the sterile F^1 hybrids were shrunken, dry and black; moreover no fibres developed on the seed-coats even though the bolls had been retained on the plant as long as three months. The ovules apparently do not develop at all." This is somewhat similar to what takes place in black bean of coffee.

Zimmermann[6] says that hybrid beans have a dissimilar colour to that of their parents and that a large number of them are barren. Of great interest in this connection is his description of the variety of coffee known as "Einsamiger kaffee" (*Coffea arabica* var. *monosperma*) which flowers profusely, but ripens only a few fruits, a majority of these being barren. In isolated cases there is one seed which is not germinable. In Java these trees are often called "mannetjes koffie". Hybrids rarely give satisfactory yields. Notable exceptions to this are the Kawisari

hybrids of Cramer, but even here a certain number of fruits are barren.

S. V. VENKATARAYAN.

Department of Agriculture
in Mysore, Bangalore,
August 26, 1938.

1 Thomas, K. M., *Planter's Chron.*, 1924, **19**, 697–704.
2 Mayne, W. W., "Annual Report of the Coffee Scientific Officer, U.P.A.S.I., 1930–31 to 1937–38."
3 von Faber, F. C., *Annales du Jardin Botanique de Buitenzorg*, 1912, **25**, 59–160.
4 Woodworth, R. H., *Bot. Gaz.*, 1929, **88**, 391.
5 Feng, C. F., *ibid.*, 1935, **96**, 485–504.
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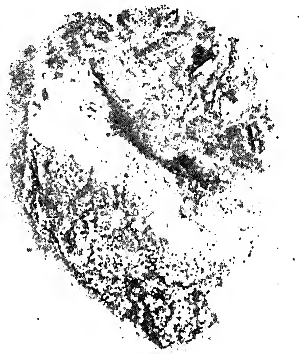
A Case of Commensalism between a Lamellibranch and a Monascidian.

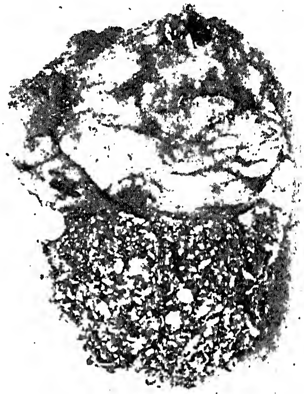
IN *Current Science*, March 1937,[1] I reported a typical case of commensalism between a Gastropod (*Turbinella pyrum*) and a Monascidian (*Herdmania pallida*) of the Indian seas, and said, "Both animals are typically Indian and it would be worthwhile to investigate the phenomenon in other Indian animals." The present communication deals with another case of commensalism between a lamellibranch and the above-mentioned monascidian. The forms were collected by me from the sea at Tuticorin, and their presence was mentioned in my monograph[2] on *Herdmania*, in January 1936. The lamellibranch was later sent for identification to Dr. Marie V. Lebour of Plymouth, who, placing it in the genus *Musculus* (Filibranchia, fam. Mytilidæ) remarked that it resembles *M. cœnobita* in its characters. The author could not get the relevant literature in India and is not quite certain if it is *M. cœnobita* or a new species of *Musculus* altogether. Whatever the species, to my knowledge this is the first time that *Musculus* has been recorded from an Indian ascidian.

My best thanks are due to Dr. Marie V. Lebour of Plymouth who kindly identified the forms for me and also sent me some references to literature on the subj ct. I am indebted to Prof. K. N. Bahl of Lucknow for giving me the necessary facilities for carrying on this work as well as for reading this manuscript.

The present species of *Musculus* inhabits the test of the monascidian *Herdmania pallida* in large numbers. In my morphological work on *Herdmania* I dissected over 200 specimens of the monascidian, and almost 80 per cent. of the animals had one or more lamellibranchs imbedded in their test. One specimen of *Herdmania* had as many as



1. *Herdmania pallida* seen from the right side, showing five *Musculus* shells imbedded in the test ($\times \frac{3}{4}$).



2. Left side of *Herdmania pallida* showing one large and one small *Musculus* ($\times \frac{3}{4}$).

3. Outer surface of the shell of *Musculus* showing its speckled and striated nature ($\times 2\frac{1}{2}$).

4. Inner surface of the same shell with the byssus attached (× 2½).

40 lamellibranchs, both large and small, in its test. *Musculus* occurs almost throughout the test, but is found more often at the free rather than at the fixed end of the animal; and is arranged in larger numbers around the branchial than the atrial siphon. Each animal is found in a cleft in the test through which it communicates with the outer world to feed and to respire.

The shell is white-speckled brownish-yellow in colour and rhomboidal in shape and bi-symmetrical. The samllest forms measured 4 mm. × 6 mm. while the largest forms were 10 mm. × 16 mm. It is sculptured by two rows of striæ (one on each side) which radiate from the beak leaving the middle part smooth. The ridges of these striæ are brownish while the depressions are white. The hinge-plate is finely notched. The umbones are incurved forming a depression at the joint. The edges of both halves of the shell are crenulated, the ends of the striæ of one fitting into the depressions of the other.

The mantle is leaf-like, rather thick and opaque on the dorsal half of the body, the anterior and posterior-most parts forming the siphons. The incurrent tube is wide while the excurrent tube is rather conical. The anteior adductor muscle is fairly high.

There is a large hairy byssus, consisting of a large number of byssus threads at the mid-ventral end of the animal (foot). The hairs of the byssus are very sticky.

The gills are rather thin and the lamellæ loosely placed. The labial palps are four in number, one pair on each side of the body. In each pair one palp is placed before the other and the lower ends of the palps are curved inwards.

The foot is strap-shaped and is quite tough.

Remarks.—*Musculus* has so far been recorded only from Temperate and Arctic Seas. The species of this genus exhibit a propensity for concealment, frequently spinning a nest of sand and shell fragments burrowing into soft substances (*e.g.*, ascidian test) or secreting themselves in the burrows of other shells. Of the three species recorded from ascidians, only *M. cœnobita* has been recorded from the Suez Canal and the Red Sea. The other forms are the British *M. marmorata*, which lives imbedded in the test and mantle (integument) of *Ascidia mentula*[3] or *Ciona*, *Ascidiella*, *Phallusia*, etc.; and *M. impacta* in *Boltenia* or other Tunicata.[4]

The association between *Musculus* and *Herdmania* appears to be constant, as more than 80 per cent. of the ascidians bear the lamellibranch in their test. It is apparent that *Musculus* gains protection from the outside world by remaining almost completely imbedded in the test substance; and also gets enough food-material as there is a constant food-current maintained by the ascidian. The fact that a larger number of forms are arranged around the branchial than the atrial siphon indicates that food brought with the current of water which enters the branchial siphon of the ascidian is also used by the lamellibranch. *Herdmania*, on the other hand, does not appear to gain any advantage by having the mollusc as a commensal. The case is nevertheless one of true commensalism between two species belonging to widely separated groups of animals.

S. M. DAS.

Department of Zoology,
Lucknow University,
August 8, 1938.

1 Das, S. M., *Curr. Sci.*, 1937, **5**, No. 9.
2 Das, S. M., *Ind. Zool. Mem.*, 1936, No. 5.
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Codling Moth in Afghanistan.

THE Codling moth (*Cydia pomonella* Linn.) is a serious pest of apples, pears and quinces in Europe, United States of America, Canada, South Africa, Australia and New Zealand. Until recently there was only a doubtful record of this insect from Dras Ladakh (Kashmir) in the Indian Empire (Fletcher, 1919) but it has now been definitely recorded from Baluchistan and the North-West Frontier Province (Pruthi, 1935 and 1938).

So far the insect has not been recorded from adjoining countries like Afghanistan and Iran.

In 1934 a few baskets of apples freshly imported from Kandhar (Afghanistan) were examined at Chaman and quite a good number of apples showed typical Codling moth injuries although no larva was found in them. In 1935 I went to Afghanistan and visited the important fruit-growing centres at Kandhar (about 4,000 ft.), Ghazni (about 8,000 ft.) and Kabul (about 5,500 ft.). On examining apples in the orchards it was discovered that most of them are attacked by Codling moth. A bagful of such infested apples was brought and caterpillars were reared from them at the Fruit Experiment Station, Quetta. The moths emerged out of them have been identified as Codling moth (*Cydia pomonella* Linn.—Family *Eucosmidæ*) by the Imperial Institute of Entomology, London. Again a good number of over-wintering larvæ were got in March, 1938, from Kandhar through the courtesy of a friend there and were reared at Quetta. The adults emerged out were Codling moths. Codling moth is, therefore, present in Afghanistan.

NAZEER AHMED JANJUA.
Department of Agriculture,
Baluchistan, Quetta,
June 27, 1938.

Fletcher, T. B., *Rept. Proc. 3rd Ent. Mt.*, Pusa, 1919, 148.
Pruthi, H. S., *Agric. & Live-stock in India*, 1935, 5, 522 23.
Pruthi, H. S., *ibid.*, 1938, 8, 42–43.

Gynura crepidioides Benth.

IN the July number of *Current Science* Dr. van Steenis of Buitenzorg has commented upon the rapid spread of *Gynura crepidioides* Benth., an African compositæ, in south-east Asia.

This plant first came to my notice in the plains of Assam, at Charduar, in 1931. Even then it was a common weed all along the foot-hills. Since that time I have watched its spread into all the districts of Assam, until now it is one of the commonest weeds in the plains.

I did not observe it at Jamiri (4000′) in the Aka Hills in 1931, but it had made its appearance there by 1934. This is remarkable because the hills between Jamiri and the plains are covered with dense evergreen tree forest.

In 1935, I noticed this species in the Naga Hills and the Deputy Commissioner, Dr. J. H. Hutton, told me that within a few years it had become common enough to excite comment. During the course of a transfrontier tour in the same year, this plant was also seen east of the Nanteilek river at Nimi (3000′) and not far from the Burmese frontier.

It is one of the commonest weeds in Sadiya where, from the rapidity with which it grows, it has become a pest in regeneration areas of *Terminalia myriocarpa*.

The rapidity with which this exotic has spread all over Assam exceeds the performance of that other compositaceous plant, *Eupatorium odoratum* Linn.

In Assam, where man is in his element as a destroyer of climax vegetation, the spread of exotics is greatly facilitated by the infinite variety of bare areas exposed. The weed *Eupatorium odoratum* Linn. which was common in Sylhet and Cachar in Hooker's day, found its way to Upper Assam barred for many years by the evergreen forest of the North Cachar Hills. The opening of the hill section of the A. B. Railway and the destruction of climax forest for cultivation in its neighbourhood, provided a convenient path by which it invaded the Assam Valley. Within the past twenty years it has established itself firmly in the plains and hills.

It is very significant that *Gynura crepidioides* Benth. is mentioned neither by Biswas (1934)[1] in his excellent account of the distribution of some foreign weeds in India and Burma, nor by Calder and his collaborators (1926)[2] in their list of species of phanerogams not included in the *Flora of British India*. One can conclude from this that *Gynura crepidioides* was absent from the flora in 1926.

For a plant to have spread all over the Province of Assam, situated as it is, hundreds of miles from any seaport, shows powers of migration and ecesis which are very remarkable. One factor which has undoubtedly a very important bearing upon its distribution is its capacity for producing flowers and fruits all the year round, as well as its tolerance towards very diverse edaphic conditions.

N. L. BOR.
Forest Research Institute,
Dehra Dun,
September 5, 1938.

1 Biswas, K., *Curr. Sci.*, 1934, 2, 422.
2 Calder, G. C., Narayanaswami, V., and Ramaswami, M. S., *Rec. Bot. Sur. India*, 1926, 11, No. 1.

Eupelmus tachardiae and its Five Hosts.

To my last criticism[1] still doubting whether *Eupelmus tachardiæ* has as many as five different hosts distributed among three families of insects, Negi[2] and Gupta have replied.

The assertions of Glover and Negi[3] were weakest with regard to *Eupelmus tachardiæ* acting as an internal parasite of lac insects; the best way to prove such a theory was to offer direct evidence, by reproducing a photograph where the lac insect, and not the lac cell, contains the pupa of this chalcid.

In order to facilitate what might have been done for *Eupelmus tachardiæ*, I[4] reproduced, in Fig. 6, a picture of a lac insect with its skin intact, nevertheless, containing the larvæ of *Erencyrtus dewitzii*, a genuine endo-parasite of lac. Imms[5] and Chatterjee, in their Fig. 34, have likewise shown a chalcid larva visible through the transparent skin of the lac insect. A similar photograph showing the pupa and not the larva of *Eupelmus tachardiæ*, would have been the proper evidence to offer.

I may perhaps now add, that the presence of such objects can be easily revealed by dissolving a colony of lac insects, suspected to be attacked by the endoparasite with alcohol; the healthy lac insects appear dark and carmine coloured, while those containing the pupæ or larvæ of chalcids possess a transparent skin, through which the contents are conspicuously displayed. When the chalcid, as imago, is dark, *e.g.*, the male of *Coccophagus tschirchii*, its mature pupa is also black and a lac insect, harbouring such a specimen of a parasite, is one of the easiest objects to discover. Now the adult of *Eupelmus tachardiæ* is even darker than the male *Coccophagus tschirchii*, besides being the largest chalcid met with lac. A lac insect, had it contained such a large and dark pupa, could not have escaped my observation, for I have used this technique for a number of years. On the contrary, Negi and Gupta never mention, in any of their writings, their ever having used such an exhaustive and systematic method of study.

All the proof they[6] have tried to bring forward is shown in their Fig. 3, where they confess, the pupa of *Eupelmus tachardiæ* is not seen within the skin of the lac insect, but merely within a lac cell. This, naturally, can be interpreted to show the pupa in question was directly associated with the larva of *Eublemma amabilis* whose remains are not seen, since the photograph unfortunately is out of focus and all details are not visible; even the complete outline of the lac cell is not reproduced.

The second and indirect evidence to show that an insect is endoparasitic is by demonstrating a large number of exist holes all indicating uniformity. That such is possible was clear by an example of *Lakshadia communis* colony attacked by *Erencyrtus dewitzii*, a chalcid which had attacked practically every cell seen in Fig. 5 of my[4] last letter. I had emphasised, that in bringing in such indirect evidence, the number of holes made by the chalcid should be large and that the colony of lac insects should not be attacked by more than one species of chalcid, even putting the words, *total and pure*, to qualify such apertures, in thick print. I would ask Negi and Gupta to bring forward similar picture of lac insects attacked in large numbers by *Eupelmus tachardiæ*.

They[2] have, however, offered Fig. 4, a single lac cell which appears, on critical observation, strange and curious in the light of their own explanation. I reproduce their Fig. 4 with my letter-markings, the exit hole, A B C D, is more rectangular than circular, which may be granted as possible, but from D to E there appears a regular cleft which makes the picture

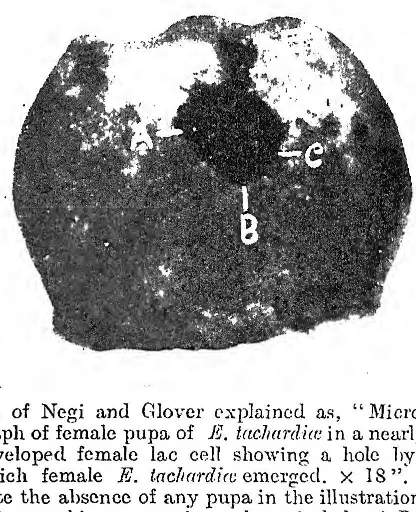

FIG. 4 of Negi and Glover explained as, "Microphotograph of female pupa of *E. tachardiæ* in a nearly fully developed female lac cell showing a hole by biting which female *E. tachardiæ* emerged. × 18". Please note the absence of any pupa in the illustration. The letter-markings are mine; the exit hole, A B C D, is rectangular, while, from D to E, there appears a regular cleft.

invalid. With regard to the exit hole they say "the greatest width of the hole made by *E. tachardiæ* shown in Fig. 4 is 0·83 mm. and the width of the head of *E. tachardiæ* is also 0·83 mm." When the head of the insect and its exit hole is of the same size, correct to 1/100 mm. I may maintain, without fear of any contradiction, no chalcid would be able to emerge on account of the great friction caused by such a narrow aperture. I find these exit holes are always larger than the size of the heads possessed by their respective chalcids.

They explain their Fig. 4, as a "Microphotograph of female pupa of *E. tachardiæ* in a nearly fully developed female lac cell showing a hole, by biting which female *E. tachardiæ* emerged. × 18". The language is so confusing, that I fail to know what they mean by a female pupa of *E. tachardiæ*. I see no pupa of any kind in their Fig. 4, nor have they lettered it.

In my last letter I had explained, a definite relationship exists between the size of the pupa of an endoparasite and that of the body of its host, particularly implying, the pupa of *Eupelmus tachardiæ* is too large for it to act as an endoparasite of lac. Negi and Gupta now admit the larval stages of lac insect are free from the attack of this chalcid. I had previously stated and might perhaps repeat, all the chalcids I have studied as directly attacking lac, have two life cycles, *one stage passing in the larval and the other in the adult stage*. Nor do I know of any other chalcid which attacks only the adult scale insect and not its larva.

The body of the lac insect is really so small that merely this consideration excludes the probability of *Eupelmus tachardiæ* acting as an internal parasite. Negi and Gupta have apparently seen this view-point while they indirectly admit that a pupa of this chalcid is so large that it cannot lie straight within the body of the lac insect; their words are, "the female lac insect measures about 2·8 mm. and the female *Eupelmus tachardiæ* larva and pupa when found in the lac females lie in a curved position (not straight as is usually the case with all chalcids) as will be seen from Fig. 3"—the text in brackets is mine. Their Fig. 3 has been already shown as being out of focus and therefore inadmissible as proving the point they claim. It would have been better to show such a pupa, with a curved body, in clear profile, *i.e.*, sideways, contrasting with the normal one, already illustrated by me.[8] They have illustrated a pupa seen ventrally,[9] which exhibits no abnormality and is, in fact, a *confirmation* of my previous picture[10] of the same object with this disadvantage, that Negi's and Gupta's photograph shows the pupa with a long white appendage, not explained either along with the illustration or in the text. I do not admit, it is ever possible for an endoparasitic pupa to mature in such a small host as to acquire an abnormal and curved body from want of space—a definite reference to a similar finding of another worker, if at all any, would shorten the controversy! In such a case the pupa would be small with the body normal and not curved. Negi[11] and Gupta state, "it was incorrect of Mahdihassan to suggest our having ever said that *E. tachardiæ* was found parasitic on the second instar lac insect". I do not believe I ever meant such a suggestion originating from them and I naturally demand a quotation from my writing which has led them make such an imputation.

The first illustration of a larval *Eupelmus tachardiæ* was published by me,[7] where Fig. 1, a pen and ink drawing, clearly shows the presence of long hairs. Negi[3] and Glover later issued another picture of it Fig. 1(*d*), which they claim as excellent but which, I believe, does not represent an improvement in showing the long hairs, which Negi and Gupta now so much wish to emphasise. They are second to give out an illustration of the larva of this chalcid and are not justified in advancing their claims of having discovered this character saying, "we are surprised that Mahdihassan who claims to know the various chalcid and braconids found in lac has not been able to notice this conspicuous difference." If my[7] previous figure of the larva had shown something less than theirs,[3] their remark would be justifiable and I leave it to the reader to compare my former picture[7] of the larva with their[3] later duplication of it and see for himself which brings out the long hairs of the larva into greater prominence. Likewise their[2] recent Fig. 1*b*, of the pupa seen ventrally, shows nothing new nor better compared with mine, Fig. 2, previously[4] offered.

Negi and Gupta, who like to live in the blissful ignorance of what has been published on lac by others, naturally take no cognizance of the fact that I have[13] already

illustrated the pupal and pre-pupal stages of the male lac insect and as such their kind suggestion that, I should consult Imm's *Text-book of Entomology* for a definition of pre-pupa, is superfluous. What was needed and what I still request of them is a definite reference to the finding of a worker on chalcids who has found these two moults, the pupal and pre-pupal, in any of the endoparasites of a scale insect.

Originally, when their Fig. 1(*c*) appeared, no details were given and it is later on that they add that their illustration represents a male and that it offers an abnormal view since the specimen was boiled in hot water, a technique as unique as it is primitive. They blame me for not knowing what they fail to communicate. The abdomen terminates, in a distinct curve towards the dorsal surface, which even in its abnormal appearance, would not characterise a male insect. At any rate, it is pertinent to ask for a pupa of female insect similarly treated with hot water and carefully photographed, for, until this is done, they have demonstrated only a mysterious object.

In their last reply, Negi[2] and Gupta bring fresh pictures, one poorer than the other, and all not quite so relevant to the main thesis. Fig. 2(*b*) shows a larva which may pass for that of an ant; the long hairs, which Negi and Gupta undertake to point out with an air of originality, are sadly missing in this picture. Fig. 2 (*a*) is so much out of focus that it may pass for the larva of a lepidopterous insect which is moreover only partly seen; while Fig. 2 (*c*) is even worse than their Fig. 2 (*b*).

In my last letter I had confessed it has not been possible for me to identify any of the internal parasites of lac by means of characteristic exit holes made by the chalcids. As though this has been meanwhile achieved by Negi and Gupta they state the hole made by *Erencyrtus dewitzii* measures 0·55 mm. while that made by *Parechthrodrynius clavicornis* measures 0·64 mm. I assert these figures are too good to be true as characters of identification and merely serve as space-filling data. They never mention the *range of variation* and the *average* size of these holes which are important factors in presenting such figures. Their respective illustrations of the exhit holes made by the above two chalcids have thus no significance. Further the exhit holes made by *Erencyrtus dewitzii* have been illustrated by me[4] previously and I find nothing new or exciting in the photograph offered by Negi and Gupta.

In their Fig. 5 is seen an adult female *Eupelmus tachardiæ* and its male in Fig. 8, both macrophotographs. Both illustrations are wanting in even such details, as distinguish the genus *Eupelmus* from *Anastatus*, so that it is impossible for any specialist on chalcids to see the specific characters of this insect. Von Gernet, long ago, illustrated both the male and the female *Eupelmus tachardiæ* and I maintain his figures enable better identification than those of Negi and Gupta. What bearing this inefficient duplication of pictures has on the points they have been all along asked to clarify, I do not see.

Negi and Gupta write, "Again Mahdihassan has indirectly tried to put into our mouth that the lac insect parasitised by *Eupelmus tachardiæ* survives and that three pupæ of *E. tachardiæ* were found in a dead lac insect, although we have never said so." I at once admit they have not said so and in exchange I wish they would accept the responsibility for such a misinterpretation of my writing. They have apparently set their hearts on creating myths and I have set mine on destroying them.

I have to thank my friend, Dr. Winkler, now of Zeiss-Werk, Jena, for kindly giving me the copy of *Current Science* where Negi's and Gupta's last letter appears.

S. MAHDIHASSAN.

The American Express Company,
Berlin,
April 14, 1938.

1 *Curr. Sci.*, 1937, **6**, 59.
2 *Ibid.*, 1938, **6**, 387.
3 *Ibid.*, 1935, **4**, 37.
4 *Ibid.*, 1937, **6**, 61.
5 Imms and Chatterjee, *Ind. For. Mem.*, 1925, **3**, Pt. 1, Fig. 34.
6 *Curr. Sci.*, 1938, **6**, 390.
7 *Ibid.*, 1935, **3**, 564, quotation from Prof. Lefroy; also *ibid.*, 1936, **5**, 292.
8 *Ibid.*, 1937, **6**, 59, Fig. 1.
9 *Ibid.*, 1938, **6**, 388, Fig. 1 (*b*).
10 *Ibid.*, 1937, **6**, 60, Fig. 2.
11 *Ibid.*, 1938, **5**, 389.
12 *Btn. Ent. Res.*, 1929, p. 241.
13 *Casopis Csl. Spol. Entom.*, 1931, ciss. 1–2, **28**—ii.

REVIEWS.

The Newer Alchemy. By Lord Rutherford. (The Cambridge University Press, London), 1937. Pp. 67. Price 3*s.* 6*d.*

This book of 67 pages contains in an expanded form the subject-matter of the Henry Sidgwick Memorial Lecture delivered at Newham College in November 1936. It contains a brief but very clear account of modern work on the transmutation of the elements. The following section headings taken from the book will give an idea of the sequence of thought followed in it: Radioactive Transformations—Elementary Particles—Detection of Fast Particles—the Expansion Method—Electric Method—Transformation of Elements by α-Particles—Discovery of the Neutron—Production of Radioactive Bodies—Artificial Methods of Transformation—Transformation by γ-Rays—General Conclusions. The book is illustrated by a fine selection of photographic illustrations amongst which the following may be noted :—α-particle tracks—β-particle tracks—records of particles by the electric method—scattering of α-particles—transmutation of nitrogen by α-particles—recoil tracks produced by neutrons—tracks in photographic emulsions showing transmutations of boron—high voltage installation at Cambridge—deuteron beam produced by cyclotron—α-particles from bombarded lithium—disintegration of boron—transmutation of deuterium by deuterons.

As might naturally be expected in a work by Lord Rutherford, the subject is handled in a masterly fashion. The book makes fascinating reading and should be in the hands of every one who wishes to read an authoritative account of the recent fundamental advances in nuclear physics and chemistry. The reviewer has read and re-read the book with the keenest pleasure.

C. V. RAMAN.

Science and Music. By Sir James Jeans. (The Cambridge University Press, London), 1937. Pp. 258. Price 8*s.* 6*d.* net.

In the present book, Sir James Jeans has endeavoured to describe the main outlines of such parts of science, both old and new as are specially related to the questions and problems of music, assuming no previous knowledge either of science or of mathematics on the part of the reader. His aim has been to convey precise information in a simple non-technical way in the hope that the subject-matter selected may interest the amateur, as well as the serious student of music.

The whole subject is dealt with in seven chapters. In the first introductory chapter, some of the basic facts regarding the nature and perception of sound are set out. The second chapter on tuning forks and pure tones gives an account of the elementary theory of harmonic motions and the result of their superposition. Chapter III deals with the physical principles of stringed instruments. In Chapter IV, the vibrations of columns of air and the theory of musical instruments depending thereon, *e.g.*, organ pipes, flutes and clarinets are considered. In Chapter V, the theories of harmony and the origins of the musical scale are dealt with. Chapter VI gives an account of the important subject of auditorium acoustics. Chapter VII which concludes the book discusses the part played by the physical and physiological laws of hearing in the appreciation of music.

Besides drawing freely on the classical treatises of Helmholtz and Lord Rayleigh, Sir James Jeans has also made use of the information contained in the more modern treatises and the technical and scientific journals. The material selected has been re-written in simple language. The book should therefore appeal to a large class of readers who desire to learn something of the scientific basis of music with the minimum of personal effort.

The book traverses much ground which is naturally quite familiar to the professional physicist. Nevertheless, Sir James Jeans' well-known gift of exposition gives a touch of interest and novelty even to what is well known and makes the reading of the book both pleasant and profitable. The excellent get-up of the book and the well-chosen illustrations help in making it an attractive publication.

C. V. RAMAN.

Reports on Progress in Physics, Volume IV. General Editor: Allan Ferguson. (Published by the Physical Society, London. The Cambridge University Press, London), 1938. Pp. 389. Price to non-fellows 20*s*. net.

The rate of progress in physics at the present time is so great and the output of papers so vast that all physicists engaged in teaching or research must feel grateful to an organisation which undertakes the task of reviewing the published literature and presenting reports on the same once a year. It is well known that the Chemical Society and the Society of Chemical Industry in London have for many years published annual reports on the progress of Pure Chemistry and Applied Chemistry respectively, and that these reports have been most serviceable to a large body of readers, including even physicists. A corresponding series of reports on the progress of physics in the English language was sadly lacking until recently. The enterprise of the Physical Society in undertaking the publication of the same is a matter for congratulation.

The volume under review is the fourth of the new series. It consists of eighteen articles edited by experts in their respective fields. Amongst the subjects dealt with may be mentioned, Sound and Ultrasonics, Heat, Thermo-Dynamics and Refrigeration, Quantum Theory and Atomic Physics, Optical Instruments and Spectroscopy, Electrolytes and Electrolysis, X-Ray Analysis of Molecular Structure and Magnetic Anisotropy of Crystals. These and other topics cover such a wide range that any physicist whatever his field of interest, is sure to find much in the reports to interest him and claim his attention. It should be profitable for a physicist to read even such reports as lie outside his own special field in order to gain some acquaintance with the progress of the science as a whole. A welcome feature found in several of the articles is that they attempt to present a coherent picture of the whole field dealt with. The relation of present progress to past work is thus more clearly appreciated.

The reviewer feels sure that these reports will be welcomed by all English-speaking physicists and will find a place on their shelves. C. V. RAMAN.

Physics in Industry. (Published by the American Institute of Physics, New York), 1937. Pp. xiv + 290. Price $ 1·50.

It is a happy idea of the American Institute of physics to issue in book form a choice collection of ten papers dealing with the rôle of physics in some important industries, that have appeared in the *Journal of Applied Physics* and in the *American Physics Teacher*, for the benefit of the general reader. In a *Foreword* to the book by Prof. K. T. Compton an analysis is made as to who is an Applied Physicist and what are his functions in relation to industry. E. C. Sullivan, Vice-Chairman of the Corning Glass Works, discusses in his paper on the 'Glass Industry' the developments made by the technical physicists who outnumber the chemists in his Works, in maintaining the quality of products, in improving the manufacturing methods and in developing new varieties of glass. In the second paper, 'Physics in the Metal Industry,' Zay Jeffries and E. Q. Adams describe the applications of physics in geophysical prospecting of metals and in mining and smelting operations. Paul D. Foote takes the reader through a course of physics pertaining to lubrication oils in 'Petroleum Industry'. In his masterful narrative he develops the theory of viscosity and the practice of lubrication side by side and suggests innumerable problems in the liquid state and surface phenomena for the applied physicist, on the solution of which depends the elimination of many troubles in the automobile industry. J. P. Den Hartog indicates the great importance of physical investigations of the problem of 'Vibrations in Industry' which has assumed serious dimensions in recent years in connection with the development of high-speed Diesel Engines and Steam Turbines. The rôle of the physicist in improving human comforts in 'Buildings' is brought out in another paper by John Ely Burchard. The three articles on the 'Communication Industry' by O. E. Buckley, 'Aeronautics' by C. B. Millikan and 'Electrical Power Industry' by Joseph Slepian deal with problems which are essentially born out of recent fundamental developments in physics and several points of interest to the industrialists, inventor, and investigator are contained in them. The last two papers contributed by Holmer

L. Dodge and A. R. Olpin discuss the problem of 'Training of Physicists for Industry' the former from the point of view of the educator and the latter from the point of view of the employer. These two papers are of special importance as they are based upon vast experience of the authors and extensive enquiry conducted by them with a view to bring the educator and the employer together and plan an acceptable course of applied physics for the future. A perusal of the book is highly instructive and is recommended to industrialists and technologists interested in higher education and in the development of applied sciences in relation to industries. C. S. V.

Physikalische Methoden im Chemischen Laboratorium. (Verlag Chemie, Berlin), 1937. Pp. 267 : 89 Plates and 38 Tables. Price 2·70 R.M.

With the advent of X-rays and modern spectroscopy, the trend of physics has been more and more to elucidate the micro or ultimate structure of matter with the aid of a number of new discoveries and methods. An important aspect of this problem, namely, the structure of molecules has been, however, the specialised study of generations of chemists, who have been able, by a systematic examination of the chemical reactions which the aggregates of molecules undergo with each other, to unravel the constitution of several thousands of molecules. The newer physical methods of investigation, such as X-rays and electron diffraction, infra-red and Raman spectra, dipole moments, etc., have now placed in the hands of the chemists some powerful tools with which to verify more directly their conclusions, or to decide between several possible alternatives which frequently crop up, and conversely to employ these methods for analytical purposes of detecting and estimating the presence of known substances.

The volume under review is a republication in a collected form of a number of articles that have been appearing in serial form in *Angewandte Chemie* since 1928, under the caption "Physikalische Methoden im Chemischen Laboratorium". Twelve of the 13 articles comprising this volume were published only during the last two years, 1936–37, and this fact coupled with the authority of the contributors to write on their respective subjects must be a sufficient recommendation for this publication. The articles are written in a manner to interest both the academic and the technical type of readers and contain copious references to original literature. Nine of the articles deal with the modern analytical methods of spectroscopy, photoelectric spectrophotometry, colorimetry, chromatography, and polarography, and the remaining four with the applications of X-rays, Raman spectra, dielectric loss measurements and ultra-sonic effects to chemical problems. M. A. G. Rau.

Perspectives in Biochemistry. Edited by Joseph Needham and David E. Green. (Cambridge University Press), 1937. Pp. viii + 361. Price 15/.

This is a collection of thirty-one essays on Modern Biochemistry presented to Sir Frederick Gowland Hopkins on the occasion of his seventy-fifth birthday, by the past and present members of his laboratory. These essays deal with a large range and variety of subjects and discuss the varied aspects of the science of life in relation to human welfare.

Professor Hopkins is the great founder and the inspiring guide of the foremost school of Biochemistry in Cambridge. His Institute attracts numerous workers from all parts of the world, and his catholic outlook and wide interest in the field of Biochemistry is reflected in the numerous lines of work which he has inspired at his laboratory. In every one of these essays, the reader will readily discover the "Hopkins touch"—a great tribute to his creative genius.

The future of biochemical thought and discovery regarding which most of the authors have allowed themselves to speculate, constitutes the most stimulating portion of the book. The eighty-fifth birthday of Professor Hopkins which we shall all celebrate in an equally fitting manner, will be the occasion to show that a good portion of the "speculations" have been experimentally substantiated.

This is a most inspiring volume which should be read by all students of biochemistry and biology. M. S.

Qualitative Analysis by Spot Tests. By Fritz Feigl. (Nordemann Publishing Co., New York), 1937. Pp. ix + 400. Price 30/- net.

The systematic study of micro-methods for the identification of inorganic elements and radicles and of organic groups, is of comparatively recent development. Progress in this field has been slow, mainly on account of the difficulty in discovering reagents, sufficiently sensitive and specific, to be of value in characterising an element or a group, in the presence of other elements or groups. The study of specific reagents has been associated with the name of Prof. Fritz Feigl of the University of Vienna and his book embodying to a large extent, the tests developed either by himself or under his direction, is perhaps the most important and comprehensive work on specific reactions and spot tests. It is appropriate that an English translation of a section of his work should have been issued and made available to a wider circle of analysts.

The merits of the micro-methods are too well known to need elaboration. Two types of qualitative tests are widely recognised: (1) The crystal formation test (using the microscope) and (2) the spot test. The biologist and the geologist are familiar with some of these tests; thus the petrologist examines crystals under the microscope for identifying them by their shape, colour and optical properties; the cytologist is familiar with the stain reactions for identifying cellular constituents. The chemist, however, has succeeded in systematising the subject and to-day, spot tests find wide application in the laboratory. Thus, under Section 7 of the book under review, no less than 55 applications have been listed, including analysis of water, detection of wood preservatives, identification of pigments used in paintings, etc. To this list, additions like the detection of food adulterants in which spot tests have proved invaluable, have to be made. The tests are incredibly simple to carry out and in the hands of an *experienced* chemist, can be almost infallible. The tests have proved exceedingly useful to biologists, geologists and medical men.

The book consists of 8 sections. The apparatus required for the tests is generally available in every laboratory, or can easily be made from material available in the laboratory. Sections 3 and 4 are devoted to tests for individual metals and acids. The interfering ions are listed under each test, and so also the values of sensitivity (usiug Schleicher and Shüll spot filter-paper); details for the preparation of the reagents for each test are also given. It is surprising to find the omission of thiourea test for bismuth. The test is specific (molybdenum may interfere) as bismuth gives, with thiourea, a yellow colour, while other metals give only white precipitates; bismuth can be detected in concentration of 1 part in 500,000. In applying the Gutzeit method for arsenic, the test can be made specific to arsine by treatment of the test spot with hot concentrated hydrochloric acid. The colouration due to stibine and phosphine disappears while that due to arsine is intensified to a brick red. An extremely valuable reagent for detecting iron, to which reference is not found in the book, is thioglycollic acid, first suggested by Lyan in 1927. Ferrous thioglycollate which is colourless in neutral or acid solution gives a strong purple colour in ammoniacal solution and as little as one part of Fe in ten million parts can be detected by this colour test. Chlorides, sulphates, fluorides and phosphates have no effect.

Section 5 is devoted to a description of the systematic analyses of mixtures. The Gutzeit's and Heller and Krumholz' procedures are described in necessary detail. Heller's procedure for the analysis of alloys is also included in this section.

The application of spot tests in organic chemistry, classified under (1) detection of elements, (2) identification of characteristic organic groups and (3) identification of specific organic compounds, forms the subject-matter of Section 6. The author has stated that the detection of organic compounds is usually less reliable and less definite than the detection of inorganic compounds. Much remains to be done in this field and further development is much to be desired. Attention may be drawn to an error under tests for enzymes on p. 316; it is mentioned that polypeptidases may be recognised by their breaking down diketopiperazine to glycocoll or glycyl-glycine. This is obviously an erorr; polypeptidases specifically hydrolyse polypeptides.

The book will be welcomed, as a very important addition to the literature on micro-chemistry now available in English.

Maintenance of High Speed Diesel Engines. By Arthur W. Judge. (Chapman & Hall, Ltd., London, 1938, Pp. 254. Price 13/6.

This book first published in 1936 now revised and enlarged, forms a good companion volume to "High Speed Diesel Engines" written by the same author. The book is profusely illustrated with leading types of Engines and contains valuable information regarding the construction of the Engines and the parts. The author has taken great pains to collect the information on the more recent servicing methods and equipment which will be required by practical men in charge of the transport vehicles. The use of I.C. Engines for transport is making rapid progress and engineers connected with the transport service will find the book, specially the chapter on reboring of cylinders and grinding of valves and valve seatings and the very comprehensive chapters on fuel injection system and timing the fuel pump, very useful. E. K. R.

Cryptogamic Botany. By G. M. Smith. Vol. I—Algæ and Fungi. Pp. 545; 24/-. Vol. II—Bryophytes and Pteridophytes. Pp. 380; 18/- (McGraw-Hill Publishing Co., Ltd., London.)

This is a most welcome addition at the present moment to the literature on Algæ, Fungi, Bryophytes and Pteridophytes. A comprehensive and up-to-date book of this type intended for the advanced student has been a long felt want. Much information is condensed in these two volumes so that they serve more or less as reference books. As the author himself mentions in the very first sentence of his Preface, "The book is designed for students who have had an introductory course in Botany and whe wish to make a more detailed study of plants below the level of seed plants".

The first chapter is a brief one dealing with the classification of spore-producing plants. In spite of the brevity, a number of controversial points concerning the phylogeny of various groups are mentioned.

The second chapter—a lengthy one—deals with Chlorophyta and is treated in a masterly manner. The treatment of a Englenophyta after Chlorophyta is not a desirable sequence. Then follow Phyrrophyta, Chrysophyta, Phæophyta, Cyanophyta, Rhodophyta, Myxothallophyta, Fungi and Lichens.

Although the auther has treated the algal groups in a way open to discussion, the rest of the book is free from such a complaint. In the chapters on Fungi some very important points which should have been discussed at length like the phylogeny of the Ascomycetes have been simply passed over.

The Second Volume deals with Bryophytes and Pteridophytes. The only complaint that can be made against this volume is that the whole matter is dealt with rather briefly. Out of 362 pages, not including the Index, 113 pages have been allotted to the Bryophytes. The literature cited is extensive.

Both the volumes contain numerous excellent figures, and typographical errors are entirely absent, as is in keeping with the traditions of the Publishing Company.

On the whole, the book can be said to be unique in its sphere and the author is to be congratulated on his successful attempt.

V. S. Rao.

Herbals: Their Origin and Evolution.—(Second Edition). By Agnes Arber. (Cambridge University Press, London) 1938. Pp. 326. Price 21*s*. net.

In the second edition, the authoress has revised the book in the light of re-orientation of her outlook during a quarter of a century since the book first appeared in 1912. She has reproduced the book in a new form. Sections dealing with botany in Spain and Portugal and the origin of herbaria are important additions to the new edition. In 326 pages consisting of nine chapters on—(1) The early history of Botany; (2) The earliest printed herbals; (3) The early history of the herbal in England; (4) The botanical renaissance of the sixteenth and seventeenth centuries; (5) The evolution of the art of plant description; (6) The evolution of plant classification; (7) The evolution of the art of botanical illustration; (8) The Doctrine of Signatures, and Astrological Botany; (9) Conclusions; together with 26 plates and 131 text-figures and three appendices on (1) A chronological

list of the principal herbals and related botanical works published between 1470 and 1670; (2) An alphabetical list of the historical and critical works consulted during the preparation of the book; (3) A subject index to appendix and a general index,—the evolution of the *printed herbal* during a prolonged period of two centuries between the years of 1470 and 1670, by no means an easy subject of investigation has been ably dealt with, mainly from a botanical and partly from an artistic standpoint. Mrs. Arber, well-known as she is for her botanical publications, should be congratulated for the trouble she has taken and the labour she has put in to rewrite the book in the present expanded and admirable form. The new edition is a boon to the students interested in the history of botany and systematic botany and will undoubtedly prove to be a valuable addition not only to the libraries of botanical institutions, but also to those dealing with the literature on art and science. The quality of printing, the illustrations and photographic reproductions including the binding,—are worthy of the high standard of the Cambridge University Press.

K. BISWAS.

The Essentials of Human Embryology. By G. S. Dodds. (John Wiley & Sons, Inc. New York; Chapman & Hall, Ltd., London.) Second Edition, 1938. Pp. vii+316. Price 20/-.

In this, as in the first edition, the author has kept in view primarily the needs of the medical students; and indeed he has thoroughly succeeded in presenting the complicated phases of developmental phenomena in an easily assimilable form by students of Human Anatomy in particular and of mammals in general. The excellently chosen illustrations accompanying the text have been executed with great care. The more important results of recent research on the Reproductive System, "the early stages of development, the ages of the embryos and the placenta, the development of the bone, the pharynx and its derivatives, vascular system and growth of nerves" have been incorporated. In view of the clinical importance of blood conditions, the account of the development of blood cells may have been treated in greater detail.

An account of the developmental anomalies associated with various organ systems forms a commendable feature of the book. The book is strongly recommended for use in medical colleges in India. A. S. R.

Systèmes de référence et de movements (Physique classique)—III. Mécanique Newtonienne et gravitation; IV. Le système absolu de la méchanique; V. L'optique des corps au repos; VI. L'optique des corps en movement; VII. L'esprit de la science classique. By Augustin Sesmat. (Actualités Scientifiques at Industrielles, Nos. 481–85.) (Hermann et Cie, Paris), 1937. Pp. 72. Price 12 *fr*.

The idea of an absolute time and of an absolute frame of reference with respect to which the motions of material bodies in the universe could be described in terms of a few principles (embodied in Newton's famous laws and his law of gravitation) was the dominating idea of classical physics. This idea acquired an additional importance on account of the method of "explanation" of physical phenomena—a method which seeks to envisage every physical phenomenon as the visible manifestation of motions of some ultimate entity or entities. Thus heat came to be explained in terms of the motions of molecules, sound in terms of the vibrations of material bodies, light in terms of the vibrations of an ether, and, in Maxwell's theory, electromagnetic phenomena in terms of the motions of the same ether. But the idea of an absolute frame of reference came up against serious difficulties with the development of the electromagnetic theory and the advent of Relativity marked its final disappearance from physics. The history of the development of the idea and of the efforts to fit into its scheme the ever-increasing array of physical discoveries is a fascinating study and M. Sesmat has presented to us in his book an admirable account of the subject. The principles of Newtonian mechanics and of universal gravitation are first set forth and the striking success of the theory, both terrestrial and astronomical, are then exhibited. The next step inevitably takes us into the domain of optics and electromagnetism, and we are led through the successive stages of the development of the wave theory and

of the electromagnetic theory, culminating in the Michelson-Morley experiment and the theory of Lorentz. From Newton to Lorentz we are shown the unfolding of a single picture, skilfully and strikingly delineated. An extensive Bibliography given at the end of the work bears testimony to the wide scholarship and erudition of the author.

While the author's account of the historical development of basic physical theory is eminently readable and attractive, it is not so easy to subscribe to his thesis of the existence of an "absolute frame of reference" and of an "absolute and universal time," with respect to which actual bodies in the universe move in accordance with classical mechanics. His definition of such a frame of reference depends on the postulate of a finite universe with a finite number of material particles, of a First Moment in world history and of an initial world-state in which all its particles are at rest. It is clear that such a definition is metaphysical rather than physical. This becomes even more evident when we find that after discussing the issues raised by the Michelson-Morley experiment with its null-result, the author asks "Que pent-il rester alors de nos conclusions anterieres?" and concludes that "tout l'essential encore..Notre premiere conclusion demere donc intacte." Naturally. Not being an idea with physical content, it is unaffected by the results of physical experiments! In the last volume a philosophic evaluation of classical physics (in the light of the above-mentioned thesis) is attempted. Here the author introduces a classification of physical magnitudes into what he calls "intrinsique" and "relationelle". The mass of a material point and the relative velocity of two points are cited (among others) as examples of the distinction. The distinction appears to be ambiguous. What, for example, is the meaning of the statement that the mass of a particle is supposed to be given absolutely apart from its "measure" expressing a particular kind of its relation to other particles? No doubt such an intrinsic property underlies the idea of "mass" as a physical magnitude but it is irrelevant to physics. Again, the length of a solid body is classed as "intrinsic" while the distance between two points is said to be "relational". May we not consider the length of a solid body (*e.g.*, a straight rod) as the distance between its endpoints? In regard to the question of Time, as might have been expected, the author adopts the idea of absolute time and of absolute simultaneity: "Notre definition du Temps physique..impliquent la thèse de l'unicité". It might be so, but one wonders if the 'time' referred to here is, in Eddington's words, the Astronomer-Royal's time. Apart from a dogmatic affirmation of the universality of time, no thorough-going discussion of this fundamental question is attempted. Indeed the author is unable to overlook the introduction of "local time" in Lorentz's theory, but dismisses it with the remark "il n'est pas le temps objectif, et nous n'avons pas à l'envisager ici". The question is whether this "le temps objectif" of the author is really physical time in the sense in which it is commonly used in Physics.

V. R. T.

An Introduction to Physical Anthropology. By E. P. Stibbe. With an Appendix by W. A. Smart, B.Sc. (Edward Arnold & Co., London.) Second Edition. Pp. vii + 228. Price 10*s*. 6*d*. net.

This volume forms a valuable addition to the literature on Physical Anthropology. Realising that Physical Anthropology has to deal with man essentially as an animal, the author has considered the subject from three view-points: (1) Comparative Anatomy, (2) Palæontology and (3) Anthropology. The author who has had the benefit of expert advice of Professor Le Gros Clark and Dr. A. H. Munter, has succeeded in treating the subject in an extremely interesting manner. This volume will be helpful to all human and comparative anatomists interested in Physical Anthropology. The anatomists in Medical Colleges in India will find in this volume much that would stimulate research in Physical Anthropology. In Part IV of the book, the author has given a clear account of the methods adopted in practical work, in both the field and laboratory. The Appendix in which is embodied a note on the statistical examination of anthropometric data by W. A. Smart, enhances further the utility of the book. The Glossary of technical terms is helpful and the book is well indexed. This book will form a valuable addition to libraries of Medical Colleges in India.

A. S. R.

Coconut Research.

WE are indebted to the Madras Presidency for a considerable proportion of our knowledge of the Coconut palm and it is an interesting coincidence that the work under review* appears just fifty years after the publication of the little monograph of J. Shortt (Madras, 1888), and fifteen years after that of Sampson's well-known book, which also originated in Madras.

Literature on the Coconut palm and its products is abundant but widely diffused through a variety of journals all over the world, in scientific periodicals, technical papers, reports of Departments of Agriculture and the like ; to a worker in any one country the original articles are often not readily available and the publication of a new collected work on the palm must always be of interest. It is a disappointment, therefore, to find the present monograph hardly adequate as a review of available knowledge, and to this criticism further reference will be made. The volume is nevertheless welcome for its presentation of the considerable amount of data collected at the four Coconut stations of the Department of Agriculture, Madras, during the past eighteen years, since much of this data had not been previously published, and since what had been published was mostly not easily accessible to the general reader.

That the volume gives most prominence to the industry and research in Madras is perhaps not a cause for criticism. The complaint was levelled against the two earlier editions (1914 and 1921) of E. B. Copeland's classic *The Cocconut*, that the Philippines were therein given a prominence not justified by the status of their coconut industry. In the third edition (1931) Copeland amply justified his procedure in that his work took as its basis the physiology of the palm, which is the same all over the world, and the author of the present monograph could make somewhat the same claim. Thus the botanical chapters III to VI, especially that on "Floral Biology", contain much interesting new material.

The method of approach to practical problems by which fundamental research precedes applied research, though apparently roundabout, is usually economical in the long run. Broadly speaking, fundamental research provides a working hypothesis upon which the applied worker can base his field trials ; as a recent writer expresses it, "It is evident that, equipped with a guiding principle, the applied worker can design his experiments with greater economy than previously and can expect to obtain conclusive results much earlier."

Had, then, the author's aim been to present an account of data collected at the Madras Stations (which he does), the reviewer's scope for criticism would have been restricted. Dr. Patel, however, in his Preface, states that the aim is "to present all the available information of importance, incorporating the unpublished results of the research carried out by the Department," and the title of the book, *The Coconut—A Monograph*, surely implies something in the nature of a complete and coherent scientific treatise on the subject. Admittedly an author making a claim like the above is entitled to elaborate the account of the work of his own department, especially where this is being reported for the first time, and in discussing this work in relation to the general body of knowledge to refer the reader to the literature for details of the latter. But this implies the provision of an adequate bibliography. The work under review is equipped with a Bibliography of eight and a half pages containing 194 references, but this is so marred by errors and misprints that its utility is seriously impaired. Lack of care in ensuring the accuracy of literature references is such a common fault in Indian scientific publications and one to which attention is so seldom drawn, that the reviewer feels that he has a duty to Indian science in general to elaborate his criticims on this score in the present instance.

Names of authors are frequently misquoted ; Philippine names seem particularly to have suffered in the present bibliography. Aurelio Cruz, for example, appears indexed under A, instead of as *Cruz, Aurelio* ; Pantaleon U. Bacomo comes under the P's, instead of as *Bacomo, Pantaleon U.* and so on. By the same error of transposition the Director of Agriculture of British Guiana appears as *Sydney, Dash J !* The well-known publishers of *Tropical Life*, appear in three different styles, the most humorous perhaps being "John Balesons,

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* *The Coconut : A Monograph*, by J. S. Patel, M.Sc. (Cornell), Ph.D. (Edin.). Pp. vii+313. (Government Press, Madras). Price Rs. 3-12.

Daniels Sons, Limited," and after two unsuccessful attempts the compiler gives up the attempt to reproduce "John Bale, Sons and Danielsson, Ltd." and refers to *The Tropical Life* Publishing Dept." These are perhaps minor points, though not the only examples which could be quoted. But what can be said of the quotation of Prudhomme's well-known book, published in Paris in 1906, as "*Prudhomme, E.* (1906). Dans les princip aux Pays de production coprah, Huile, fibre de coco et dérivés divers. Par. Paris"? The title-page of the work in question reads "*Le Cocotier.* Culture, Industrie et Commerce dans les Principaux Pays de Production. Coprah, Huile, Fibre de coco et Dérivés divers. par E. Prudhomme." It would suffice to quote simply "Le Cocotier", without the subtitles. The author has perhaps been wise in not giving a single other reference (one to a Tamil work excepted) to a non-English publication, not even to the essential works of Preuss and Hunger. Even worse is the confusion in one or two references between *The Tropical Agriculturist* (published in Ceylon since 1881), and *Tropical Agriculture* (published in Trinidad since 1924). Neither is there much to be said for the eleven references to *The Experiment Station Record* (the abstracting journal of the U.S. Department of Agriculture), since in these cases references are not given to the original articles. It is, moreover, very common for periodicals dealing with Tropical Agriculture to reprint articles from other journals concerned with the same subjects. This has led the author to give two or more references to one and the same article in more than one instance. Not that there is great harm in this. Workers in the tropics generally have very limited library facilities and in such cases may have available a journal in which a particular article has been reprinted or abstracted, and not that containing the original article. But surely it is better for the bibliographer to exercise a little care and to aim at some standard of literary exactness. In referring to a particular article, the original reference should be given first, followed by references to reprints of the article in other journals and then by reference to summaries in abstracting journals. For example :—

Galvez, N., Moreno, R., and Lava, V. G., (1928), Chemical Studies on coconut products. II. Utilization of the coconut. *Philippine Agric.*, 1928, **17**, 163–68. Reproduced in *Trop. Agriculturist* (Ceylon), 1928, **72**, 41–44. Abstr. in *Chem. Abstr.*, 1929, **23**, 295.

Other faults noticed have been occasional omission of page numbers, incorrect spelling of foreign place names, and some confusion in titles of journals, when, as often happens, these have been altered by the publishers at some stage of their history. Thus the *Malayan Agricultural Journal* appeared from 1912 to 1921 as the *Agricultural Bulletin of the Federated Malay States.*

The reviewer, in thus elaborating the often minor faults of the bibliography in the book under review, does not intend to imply that it is an outstandingly bad one of its kind. Many worse have come to his notice, and he recollects a particular, rather pretentious, work which achieved the masterpiece of four gross errors in a single line of literature reference. Rather does he wish to do a service to Indian science by suggesting that the value of published work can be much increased by a little care to avoid inaccuracy.

The present bibliography can, however, be further criticised on the ground of inadequacy; it is nowhere near to being a satisfactory review of the literature. As mentioned above, no reference to important German and Dutch work is to be found at all, nor, except for an occasional mention of Prudhomme (spelled "Prudhoum" in the text), to work in the French Colonies. The limited scope of the bibliography can perhaps be indicated by the fact that of the 194 references, 43 are quoted from the *Malayan Agricultural Journal*, 28 from the *Tropical Agriculturist* (Ceylon), and 25 from the *Philippine Agriculturist*, a total of fifty per cent. from three journals. It is even more striking to mention that a bibliography on the Coconut palm and its products, in course of preparation by a colleague of the reviewer, already contains over 2,500 original references.

One does not necessarily expect such an encyclopædic review; but one is entitled to expect that the author of a scientific monograph shall have exercised some critical faculty in surveying the literature, especially when he claims "to present all the available information of importance". It is unfortunately the reviewer's opinion that the author has not made that extensive survey of the subject which would justify such a claim and his bibliography is in no sense a "selected" one.

The chief value of the book therefore remains in its presentation of some new data. Even here the facts brought forward are not well digested. The author might ponder the following: "A vast number of observations without order or regularity is not unlike a confused heap of stones, lime, beams, and rafters requisite for constructing an edifice, but which being combined with no skill fail in producing the proposed effect" (T. Bergmann, *De indagando vero*, 1779). For this reason, *i.e.*, a disconnectedness in treatment, the book is by no means easy to read. The author's use of mathematical analysis is commendable, but the general reader will find it heavy going, and the author has not entirely succeeded in his design of presenting, at the end of each chapter, the main conclusions in simple language.

In complaining of the inadequacy of the account of present knowledge, the reviewer is not referring to the omission of fairly recent work. He appreciates that it is impossible to make a book of this nature "up-to-the minute", and that an author must set a time-limit, about 1934 in the present case. Since this date there has been much activity in the field of Coconut research.

Systematic research on the Coconut palm started rather late. The Philippine Islands were early in the field, with the help of American scientists from about 1906, but it is only comparatively recently that other producing countries have organised scientific work. A Research Institute with a full-time staff commenced operations in Ceylon in 1933; the Department of Agriculture, Straits Settlements and Federated Malay States, appointed in 1929 a full-time officer for Copra Research; notable entomological work has been done recently in Fiji; stations in the Dutch East Indies are devoting much time to the study of the palm. Other examples could be given, and it is clear that the next few years will see considerable advances in knowledge.

In the meantime, as the author of the book under review himself points out, there are enormous gaps in our knowledge. On the general subject of manuring, data are scanty and conflicting. Field experiments on Coconut palms take a long time, which is one of the reasons why so few have been started. So far, in fact, only one manurial experiment employing modern technique has been reported, that carried out in Ceylon by Imperial Chemical Industries (India), Ltd., whilst the Coconut Research Scheme of Ceylon, commenced a comprehensive N.P.K. experiment in 1934, after a careful preliminary study of the experimental errors involved in such experiments.

On cultivation methods, still less reliable information is available, and in any case each country will have its own problems related to its own conditions of soil and climate. In several countries controversy rages round the utility of green manures and cover crops, and here again the paucity of information is illustrated by the fact that the present monograph scarcely touches these questions at all.

A popular account of the Coconut palm of a wildly enthusiastic nature in 1914 described coconuts as "The Consols of the East". Technical development and competition in the oil and fat industries have discounted former advantages possessed by coconut oil in the world's markets. In the face of trade depressions, tariff barriers and intense competition the producer has to consider, as he had not twenty years or even ten years ago, how to reduce to a minimum his cost of production. The answer is not to abandon cultivation and manuring, as many have done, regardless of the obligations to future generations which the ownership of land implies, but to evolve, with the aid of scientific research, the most efficient and economical methods of working.

There is a tendency in times of depression to regard research as a luxury. It is, however, false economy in the long run to cut down research expenditure at such times. What is wanted to enable the coconut industry to maintain itself successfully is more research, not less, and more application of the results of research.

The publication of the present monograph, in spite of many faults to which attention has been drawn, will undoubtedly do a great service in calling attention to this need for continued research on the Coconut palm and its products, and in stimulating workers in the same field elsewhere. The reviewer would acknowledge that he has found the perusal of the book provocative of ideas, particularly on the methods of attack on the many outstanding unsolved problems.

The book is, then, one to be welcomed, but it might have been so much better.

R. Child.

CENTENARIES.

S. R. Ranganathan, M.A., L.T., F.L.A.
(*University Librarian, Madras*)

Boerhaave, Herman (1668-1738)

HERMAN BOERHAAVE, a Dutch physician, scientist and philosopher, was born at Vocrhoat, near Leyden, December 31, 1668. He lost his mother in his fifth year. He was designed by his father for the ministry and hence was made proficient in languages even before he was eleven. But a cancer in his thigh interrupted his studies at this stage for a few years. He then joined the public school at Leyden where he made phenomenal progress, carrying away all the prizes that came his way. When he was about to enter the University, his father died leaving him but slender means to prosecute his studies. But his genius and industry gained scholarships and prizes for him and with their aid he took the degree of Doctor of Philosophy on the basis of a thesis—*On the distinction between the soul and the body* (1689). Then he pursued his scientific studies, mathematics, physics, chemistry, botany and medicine which culminated in another doctorate in 1693 at Herderwick.

After practice in Leyden for a few years, he was elected lecturer of the University of Leyden in 1701. *De usu ratiocinii mechanic in medicina* (1703), *Institutiones medicæ* (1707) and the clear classification, causes, and cure of diseases given in the *Aphorismi de cognoscendis et curendis morlies* (1708) spread his reputation far and wide. His new medical system was widely adopted by his contemporaries.

In 1709, he was elected professor of medicine and botany. In 1710, he brought out his *Index stripuim in horto academico.* In 1718 he occupied also the chair of chemistry and his *Elementa Chemice* was reputed to be the first popular rendering of chemistry in a clear and beautiful style. He published also half a dozen other treatises on subjects like anatomy and materia medica.

When he laid down the office of the Governor of his University in 1715, he made an oration in which he declared in the strongest terms in favour of experimental investigations and rigorous mathematical deductions and showed the futility of purely speculative methods. Some of his contemporaries, steeped in jealousy and envy invoked both by this erudition and by their inability to comprehend his writings, read into this oration an anti-christian attack and made a move to darken his reputation. But the University put down such calumnies with a stern hand and when he was asked what punishment should be meted to his mean adversaries he said, "that he should think himself sufficiently compensated, if his adversary received no further molestation on his account." He used to say of calumny, "They are sparks, which, if you do not blow them, will go out of themselves."

Such interested and judicious attacks on a reputation founded upon solid merit merely helped to enhance it. In 1720 he was elected a member of the Academy of Sciences at Paris. Two years later he was elected a Fellow of the Royal Society of London. His fame extended even to the furthest parts of Asia. It is said that a Chinese Mandarin addressed a letter to him with the superscription "To Boerhaave, Physician in Europe" and that the letter was duly received. When he recovered from a long illness in 1732, the inhabitants of Leyden celebrated the joyful event by a public illumination.

After a long and painful period of illness, Boerhaave died at Leyden, September 23, 1738.

Courtois, Bernard (1777-1838)

BERNARD COURTOIS, the discoverer of iodine, was born in 1777. He employed himself in the manufacture of saltpetre near Paris. In 1811, he discovered iodine accidentally. He reported this discovery to *Annales de Chemie* (1813) in two papers entitled *Decouverte d'une substance nouvelle (iode) dans le vareck* and *Sur un nouvel acide forme aved l'iode.*

In his process for procuring soda from the ashes of seaweeds, he found the metallic vessels much corroded. He traced this effect to a new substance in the bye obtained by extracting the weed with water. He wrote "The mother-liquors of the bye obtained from vareck contain a tolerably large quantity of a singular and curious

substance. It can be easily obtained... The wonderful colour of its vapour suffices to distinguish it from all other substances known upto the present time."

Soon after its discovery, Courtois gave specimens of it to Deormes and Clement for chemical examination. They presented a memoir on it at a meeting of the Imperial Institute of France in November 1813. A few days later, Gay Lussac received a specimen of this substance and after a careful study designated it *iode*. He also prepared and named *hydriodic acid*. Humphrey Davy who was then at Paris received a complementary specimen from Ampere and he confirmed the conclusions of Gay Lussac in a communication sent to the *Philosophical transactions* of the Royal Society in 1814–1815. Mellor records that "H. Davy played a not too glorious part" in the affair.

Courtois died September 27, 1838.

ASTRONOMICAL NOTES.

Planets during October 1938.—Venus will continue to be a very bright object in the western sky soon after sunset, and will attain greatest brilliancy on October 16, the corresponding stellar magnitude being —4·3. On October 30, the planet will be at one of the stationary points of its orbit. Mars will be visible as a morning star, rising about two hours before sunrise, but will still not be well placed for observation. The close conjunction of the planet with Neptune on October 12 is worth observing, the angular distance between the two being only five minutes of arc. A small telescope will however be required for observing the phenomenon.

The two major planets Jupiter and Saturn will be conspicuous objects that can be conveniently seen in the early part of the night. The former is nearly stationary among the stars during the month and will be on the meridian at about 8 P.M. Saturn will be rising at about sunset; and on October 8, the planet will be in opposition to the Sun. The major and minor axes of the ring ellipse are 45″ and 7″ respectively. An occultation of Uranus by the moon will take place at about 10 P.M. on October 11, the reappearance being at the dark limb can be observed even with a binocular. Another lunar occultation of interest that can be seen in these latitudes is that of B. Capricorni, a third magnitude star which will occur at about 9 P.M. on October 3.

A General Catalogue of Stars.—The Department of Astrometry, Carnegie Institution of Washington, has recently published in five volumes, an extensive catalogue, providing standard positions and accurate proper motions of a large number of stars well distributed over the whole sky. The catalogue includes all stars brighter than visual magnitude 7·0 and contains, besides, a number of fainter stars with fairly well determined proper motions. An elaborate investigation on the solar motion, the constants of precession and galactic rotation, has been made by R. E. Wilson and H. Raymond (*Astro. Journal*, 1084) based on the large amount of material contained in the New General Catalogue. Their discussion indicates small corrections to Newcomb's tables of precession. Referred to stars brighter than 7·0 magnitude, they find for the position of the apex of solar motion R.A. 270°·4, Declination 33°·2 N. As is well known, there are marked changes in the position of the apex depending on the magnitude and spectral types of stars whose motions are used in the investigation.

T. P. B.

OUR scientific method has been giving us better and better maps of our universe, mapping it from the points of view of physical science, of biological science, later of sociology, and finally of education. From the philosophical point of view we can not be at all certain that we have made any progress toward an understanding of the absolute nature of things, but we have made a practical progress in these useful guides for our race. The mapping that has been done in the first two fields named has been far more complete than in the others, and therefore is subject to much less criticism.

DINSMORE ALTER.

INDUSTRIAL OUTLOOK.

Industrial Carbon Dioxide from Fermentation of Cane Molasses.

By N. Sreenivasan.
(*The Mysore Sugar Co. Distillery, Mandya.*)

THE problem of the economic disposal of molasses, has been engaging the attention of scientists and industrialists. The production of power alcohol and industrial carbon dioxide offers the most rational and satisfactory solution to the problem; the employment of molasses as a fertilizer is still under experiment.

The dissolution of carbon dioxide in water, results in a sparkling liquid with a characteristic taste, originally discovered by Priestley, and now widely appreciated by the public. With the advent of liquid carbon dioxide and later its conversion into solid, "dry ice", its industrial applications have been greatly extended. The modern tendency is to produce straight the solid carbon dioxide, "Converters" being used wherever the gaseous and liquid forms are required. In America, for example, 90 per cent. of the concerns making liquid till 1923 have changed over to "dry ice" manufacture and at present, there is a production of 700 tons[1] of dry ice per day.

In India the industrial possibilities of the solid product have not been fully explored. Attention may, however, be drawn to the pioneering work of the Dry Ice Corporation of Bombay, which is trying to popularise the use of dry ice for cold storage and cold transport.

Manufacture of Solid Carbon Dioxide.

The fermentation carbon dioxide industry in early days fell into disrepute, because the final product had the bad odour of the raw fermentation gas. With the advent of modern purification process, no stigma rests on the product and in 1929, 348,000 tons of carbon dioxide was produced from the industrial alcohol manufacture in U.S.A.[2]

Of the Backus and the Reich systems of purification, the latter is said to produce the best grade of gas. The first stage in the Reich process is to pass the gas from the fermenter through a "catch-all" with dilute alcohol solution to rid the gas of entrained wash, etc. Next, the gas is well scrubbed and collected in a gasometer and from there, it is compressed to about 75 lbs. per square inch and passed through the next stage of purification. This step comprises the oxidation of organic impurities by passing the gas through dichromate and sulphuric acid scrubbers. Next, the sodium carbonate tower removes traces of the entrained acid and incidentally dries the gas. The final washing is done with compressor oil which removes the impurities produced during the oxidation processes.

Modern dry ice practice insists on a perfect dry gas because of the prematurely formed ice and this is accomplished by silica gel tower. Purified, de-odorised and "bone-dry" gas enters the second stage of compression cycle at a pressure of about 75 lbs. It is compressed to about 420 lbs. per square inch and led through the refrigerating cycle.

The refrigerating cycle best suited for tropical climates is what is technically called a binary cycle, consisting of the CO_2 and NH_3 cycles. The compressed gas under a pressure of 420 lbs. passes through the condenser of the system, which is the evaporator of the ammonia cycle. The carbon dioxide is completely liquefied. Ammonia being a more efficient thermodynamic medium than carbon dioxide, considerable thermal advantage is gained over CO_2; the entire system can be worked at a pressure below 30 atmospheres.

The liquid CO_2 thus formed is passed through an expansion valve into a "snow" chamber where solid CO_2 is formed. The American practice is to subject the solid formed to about 2,000 lbs. pressure and form $10'' \times 10'' \times 10''$ blocks weighing 52–55 lbs. On the Continent, the necessity for pressing the solid is eliminated by an ingenious method followed in the "Carba Process".[3]

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[1] *Chem. & Met. Eng.*, 1933, 40, 76.

[2] *Carbon Dioxide*, by E. L. Quinn and C. L. Jones, Reinhold Publishing Corporation, New York, 1936.

[3] *Ibid.*, 2.

To provide maximum flexibility for merchantable products, arrangements can also be made for drawing the liquid CO_2 from the condenser into pressure cylinders and sold direct.

Disposal of the Product.

By virtue of its high refrigerating effect, about 278 B.Th.U. per lb., the insulating and desiccating action of the gas evolved, dry ice is eminently suited for refrigeration work. Unlike water-ice, the combination of functions of the dry ice can very well be expressed by a new American catchword, *viz.*, "Statifrigeration" or "Coldservation"[4] meaning collectively all the factors involved in keeping a product cold as distinguished from cooling it.

Cold storage and cold transport in India have immense possibilities. The report of the Royal Commission on Agriculture has pointed out the remarkable benefits which refrigeration had conferred on the export and local consumption trades in other countries and recommended that India should adopt similar measures. The preservation of perishable goods in India is a problem affecting millions of agriculturists.

Sir John Russel, in his recent report on Indian Agriculture, has pleaded for increasing the production of fruits and vegetables and for the adoption of cold storage and cold preservation, so that the Indian diet may include more of these essentials of food. The Agricultural Marketing Officer to the Government of India has reported[5] that the quantity of perishables produced annually in the City of Delhi amounts to about 69,000 tons, of which 20 to 50 per cent. is wasted for want of proper storage facilities. The annual output of fruits in Mysore is valued at Rs. 84 lakhs, more than a third of which (about 32 lakhs) is exported.

At present water-ice is being used as a transport refrigerant in small quantities. But, dry ice is better, one pound of which is equivalent to 10 lbs. of water-ice. Freight is thus reduced and there is no untidy melting.

In addition there is a considerable amount of consumption of industrial CO_2 in the baking, confectionery, ceramics, cement, sugar, white lead, mineral water and ice cream industries. The problem of seasonal storage of solid CO_2 is not serious, since storage structures of the order of 3,000 to 4,000 tons are being used by the Dry Ice Corporation of America.[6]

Cost of Production.

A distillery producing 1,550 gallons of 96° Gay Lussac alcohol per 24 hours, for 240 days a year, using the process detailed above, can produce 5 tons of dry ice per day.

1. *Capital Investment.*—

	Rs.
Plant, royalty	2,06,000
Additional buildings	27,000
Erection, etc.	13,500
1,500 steel cylinders for liquid CO_2 (40 lbs. and 20 lbs.)	90,500
Containers for "dry ice".	13,500
Total ..	3,50,500

Say, a maximum of 4 lakhs of rupees.

2. *Daily Operating Cost.*—

	Cost per day Rs.	A.	P.
Power—200 H.P. for 24 hrs. at 0·6 anna per K.W.	135	0	0
Chemicals (Sulphuric acid, ammonia, soda and water)	50	0	0
Labour—9 men at As. 12; 12 men at As. 8	19	8	0
Supervision	15	0	0
Repairs and Supplies	30	0	0
Over-head—			
Depreciation, Interest, Insurance at 20 per cent. of 4 lakhs	335	0	0
Merchandising—			
Sales, Commission, Advertisement ..	20	0	0
Total ..	604	0	0

Total production cost per day = Rs. 605.

3. *Summary of Returns.*—

	Rs.
By sale of 2·5 tons of liquid CO_2 at As. 2 per lb., ex-factory	700
By sale of 2·5 tons of dry ice at As. 1-6 per lb., ex-factory	525
Total returns per day	1,225
Total cost per day	605
Net return per day	620

For 240 working days = 240 × 620 = Rs. 1,48,800.
Net return = 37 per cent. on an investment of 4 lakhs of rupees.

[4] *Ibid.*, 1, 76.

[5] *Report of the Agricultural Marketing Adviser to the Government of India* on "Cold Storage and Cold Transport of Perishables in Delhi," 26th October 1937.

[6] *Ibid.*, 2.

RESEARCH ITEMS.

Resolution of Racemic Amino-acids.—For splitting racemic amino-acids into optical antipodes by the usual Fischer's method fairly large quantities of the alkaloidal salts of benzyolated or formylated amino-acids are employed. To obtain small quantities of optically pure amino-acids by the above method is, however, very bothersome. It has been found that by using active cholestenonsulphonic acid which forms crystalline compounds with amino-acids, the salt of one of the antipodes being more difficultly soluble than the other, ready separation can be effected directly (George Triem, *Ber.*, 1938, **71**, 1522). In this way optical antipodes of leucine, tyrosine, and α-amino-butyric acid have been prepared. With amino-succinic acid the product was optically active though not optically pure.

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Urinogenital Ducts of *Ambystoma tigrinum*.—L. T. Rodgers and P. L. Risley have determined the period in the development of *Ambystoma tigrinum* when the sexual differentiation of the urinogenital ducts takes place (*Journ. Morph.*, *July* 1938, **63**, No. 1). Till a very advanced stage near metamorphosis the indifferent condition in the urinogenital ducts continues, the first signs of differentiation appearing with the formation of the spermatocytes in the male and the oocytes in the female. The differentiation of the secondary sexual characters which make their appearance with the release of the sex hormones by the gonads takes place during or after metamorphosis in the male and before metamorphosis in the female. The post-metamorphic changes consist in the male mainly in an increase in size, in the activity of the epithelia of the ducts. The attachments of the collecting ducts to the wolffian duct shift posteriorly. The females retain the larval condition of the wolffian and collecting ducts. There is an increase in the size of the oviducts also.

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Intestinal Protozoa in Captive Mammals.—At the request of the Secretary of the Zoological Society of London, the fæces of mammals temporarily quartered in the sanatorium of the Zoological Gardens, were examined for intestinal Protozoa and a complete account of it is given by D. L. Mackinnon and M. J. Dibb [*Proc. Zool. Soc. Lond.*, (B), 1938, **108**, 323]. 107 Mammals belonging to 77 species were examined. Commonly cysts of amœbæ were found. These belonged to *Entomœba histolytica*, *E. coli* (?), *E. muris*, *E. bovis* (?), *E. polecki*, *Iodamœba* and *Endolimax nana*. Flagellates like *Chilomastix* and *Trichomonas* and cysts of *Giardia* were noted. *Balantidium* sp. and a Coccid probably *Eimeria sciurorum* were also observed in the fæces.

* * *

Chondrocranium and Branchial Skeleton of *Salmo*.—Dr. V. Tchernavin has brought to light many points which were hitherto obscure in the cranium of *Salmo* [*Proc. Zool. Soc. Lond.*, 1938, (B), **108**, 347]. The palato-quadrate is long and possesses an equally long orbital process which reaches the mesopterygoid. Some specimens of *S. trutta* reveal two ossifications upon the mesopterygoid in the orbital process region. The left branchiostegal is better developed than the right. The anterior copula is related to the hyoid and first two branchial arches; the posterior copula bears relation with the three posterior branchial arches. There are two pairs of dentigerous pharyngeal plates. The anterior myodome is differently developed in the several species of *Salmo*. Similarly the mesethmoid; no true mesethmoid occurs in *S. salar* and *S. irideus*. The supraethmoid is free from the true mesethmoid. Some features of the skull of *Salmo*, have undoubted taxonomic importance.

* * *

Fossil Amphibia from Czechoslovakia.—The amphibian fauna of the Carboniferous and permian beds of Czecholsovakia are important not only from the point of view of its richness but also from the view-point of the transition that exists from one bed to another. In an exceedingly important paper, M. C. Steen [*Proc. Zool. Soc. Lond.*, 1938, (B), **108**, Pt. 2] has given an exhaustive systematic account of the four orders, namely, Lepospondyli, Adelospondyli, Labyrinthodontia and Phyllospondyli, a classification based on the nature of the vertebral column. Under the first order, a new species *Ricnodon limnophyes* sp.n. and under the third, four new genera (*Memonomenos*, *Capetus*, *Lusor* and *Ptomochoston*) and under Phyllospondyli, a new genus (*Mordex*) and a new species (*Melanerpeton potamites*) are described. *Ricnodon* is tentatively referred to Lepospondyli, from the view-point of the nature of vertebræ while the relationship of the Labyrinthodont *Memonomenos* and *Capetus* are not definitely settled. The Loxommoideæ (Watson) are not ancestral to Rhachitomi and forms a specialised group. The latter undoubtedly exist as an independent one in the upper Carboniferous. The Anthracosaurus possessing Embolomerous type of Vertebræ and considered to belong to Reptiliomorpha by Save-Söderlbergh are "identical with those believed to belong to the Loxommids". The Seymouriamorpha while possessing amphibian skull are definitely reptile-like in their vertebral elements. According to the author, the four orders of fossil Amphibia had each an independent origin from a central parent group and Phyllospondyli and Labyrinthodontia are more closely related.

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Development of *Haliotes tuberculata*.—The contribution of D. R. Crofts on the development of *Haliotes* [*Phil. Trans. Roy. Soc. Lond.*, (B), 1937, **228**, 552] throws a flood of light on gastropod ontogeny. *Haliotes* completes its development in about two months and the trochophore lacks apical cilia and a telotroch, but the veliges develops transitory apical cilia. The origin of mesoderm is similar to that in *Patella*. The operculum arises prior to torsion and the asymmetrical velum retractor muscle does not become the columellar muscle and the former is responsible for the first 90 per cent. of the torsion. Growth and migration of the columellar muscle is responsible for the second half of the torsion. The development of ctenidia, nerves and digestive organs is also described. The characters peculiar to *Haliotes* arise when the larva becomes pantigrade. The operculum does not fall away till its function is lost,

A History of the International Geological Congresses.*

By Cyril S. Fox, D.SC., M.I.Min.E., F.G.S.

Introductory Remarks.

It is a good argument against any direct descent of a man from apes that these animals have never had intelligence enough to make weapons of stone ; but it is a long road in the progress of human civilization since primitive man learned to select material for his stone implements to the day in 1778 when de Luc coined the term *Geology* and de Saussure adopted it a year later. By this time science was already established along several lines for special study, and scientists had learned to appreciate the value of meeting for an exchange of views on their observations and discoveries, and thus it came about that the Geological Society of London was founded in 1807—"....to foster right thinking on the mysterious problems presented by the planet on which we dwell." It was even claimed by the same writer[1] that it was geological "...science which guided the miner to the coal, ...conducted water to our thirsty cities, poured the gold of Africa into the lap of commerce, and discovered diamonds to adorn the fair."

Exploration is the spirit of geology and thus it was that geologists seized opportunities to travel, and in this way, as early as 1824, we find an account of the 'Geology of Russia' by William Strangways who had studied the Volga basin and visited extensively elsewhere in European Russia. However, it was fully understood at that time that such investigations were useful in obtaining a general idea of the geological features of a region, but that geological mapping like topographical surveys, because of the expense involved and the public benefit derived from them, were duties best undertaken by Government. The first State survey of this nature was that of the Geological Survey of Great Britain established in 1835. Its usefulness may be presumed from the fact that it celebrated its centenary in 1935 by being provided with a new building specially designed for its offices and museum in South Kensington. Canada established a Geological Survey in 1842, India initiated its Geological Survey about 1845, and many other countries followed soon after. Three famous geologists—Murchison, De Verneuil and Keyserling were invited by the Tzar Nicholas I to make a geological study of the Ural-Volga region about that period and their results, published in 1845 in two volumes—'The Geology of European Russia and the Ural Mountains'—does not appear to have convinced the Russian Government to establish a geological survey then. It was not till 1882 that the Russian Geological Committee (Survey) was sanctioned and it appears to have been regarded more as an academic luxury than with any hope of usefulness as a return for its upkeep.

With the establishment of geological surveys in most civilized countries since 1835 and the appearance of published reports and maps of areas all over the world, it was quickly noted that geologists even in adjacent countries studying the same rock formations were evolving geological terms which were dissimilar and often confusing. There was in fact a gradual development towards a veritable 'Tower of Babel' in geological classification and nomenclature before 1876 when, after the exposition at Philadelphia, a meeting of the America Association for the Advancement of Science was held on the 25th August 1876, at Buffalo, New York, with Professor W. B. Rogers as President, to consider this matter. A resolution was passed that a committee be formed to endeavour to hold an International Geological Congress at the Paris Exhibition which was fixed for 1878. The Committee was elected the same day at the Buffalo meeting and Professor James Hall chosen as Chairman and Dr. T. Sterry Hunt selected as Secretary. This Committee assisted by geologists in other countries and especially by the Societe Geologie (France) successfully arranged for the first session of the International Geological Congress to meet in 1878 in Paris with the special object of establishing an international geological classification and nomenclature.

First Session in Paris.

At the *First* Session of the International Geological Congress held in Paris in 1878 the President, E. Herbert, in his address complained that geology "...remains a science of the initiated, because it does not yet present in its language that general character possessed by other sciences and facilitating the study of them." He continued—"It is to supply this want that you are assembled here. Science is of no country; there can be among us no rivalry other than that which results from the pursuit of truth." Whether an invitation to attend this first Congress was received in India or not is not now certain, but it is doubtful if any officer of the Geological Survey of India could then have been spared. H. B. Medlicott and W. T. Blanford were then heavily engaged in the preparation of the *Manual*, which was published in 1879, on the Geology of India.

The *Second* Session, with G. Capellini as President, was fixed to be held in September 1881, in Bologna and it was to attend this that sanction was finally accorded to W. T. Blanford who was sent in place of H. B. Medlicott. The proceedings and papers of the Congress were published in two volumes of *Compte Rendu* (Bologna, 1882). Blanford's report is in our Records,[2] but attention is drawn to the elaborate papers by Professors Albert Heim (Zurich) and A. Karpinsky (St. Petersburg) on a standard scheme of signs and colours for geological maps.

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* With the permission of the Director, Geological Survey of India.

[1] W. J. Sollas, at the Centenary Meeting of the Geological Society in London, 1907.

[2] *Rec. Geol. Surv. India*, 1882, **15**, Part 1.

BERLIN, 1885.

The *Third* Session of the International Geological Congress was held in September 1885, in Berlin, with E. Beyrich as President. Blanford, who had already retired from the Geological Survey of India, attended the session at which he submitted a 'Note Sur la classification des roches de l'Inde Brittanique'. In this paper, published in the *Compte Rendu* of the Congress, he gives separate tables of the formations in the Peninsular and extra-Peninsular areas. In these he shows he is in agreement with the terms:—*Group* (= Era) divided into *Systems* (= Periods) sub-divided into *Series* (= Epochs) which consist of *Stages* (= Ages) which were suggested at the Bologna (1881) meeting. He includes the Pleistocene (series) in the Pliocene (system) and thus in the Kainozoic (group). His report on the Congress is published in the Records.[3] Professor E. Renevier, who had been detailed at the 1881 meeting to go into details regarding the preparation of a geological map of Europe (1 : 1,500,000) and perhaps the most important matter at the 1885 Congress, produced, with Professor Albert Heim, a splendid report. It gives elaborate details of a colour scheme suitable for sedimentary and igneous rocks and for an acceptable stratigraphical sequence, which is also given in the *Compte Rendu* of this Congress (Berlin, 1888).

LONDON, 1888.

The *Fourth* Session of the International Geological Congress was held in London in 1888 with J. Prestwich as President. We were well represented by W. T. Blanford, V. Ball, R. Lydekker and H. B. Medlicott on the retired list, but we had sent no delegate. Blanford's report as "President of the Geological Society of London on the International Geological Congress of 1888" was published in our Records.[4] At this Congress special committees dealt with the stratigraphical sequence—Archæan, Lower Palæozoic, Upper Palæozoic, Mesozoic, Kainozoic, Quarternary and Recent, as well as with the ever recurring questions of classification and of nomenclature.

The *Fifth* Session was held in Washington in 1891 with J. S. Newberry as President. There was an important paper on "The Pre-Cambrian Rocks" by C. R. Van Hise among other valuable contributions. The excellent series of excursions evidently formed an attractive part of the Congress meeting as they included journeys to all the notable areas of United States geology. The *Sixth* Session was held at Zurich in 1894 under E. Renevier, whose contribution, 'Chronographe Geologique—Tableau des Terains Sedimentaires formes pendent les epoques de la Phase organique du Globe terrestre," remains as a classic in geological literature and should be better known. R. D. Oldham[5] attended this Congress after completing the second edition of the *Manual of the Geology of India*.

[3] *Rec. Geol. Surv. India*, 1886, **19**, Part 1.

[4] *Ibid.*, 1889, **22**, Part 3.

[5] The second edn. *Man. Geol. India* was published in 1893.

RUSSIAN MEETING OF 1897.

The *Seventh* Session of the International Geological Congress was held in St. Petersburg in August 1897, under the presidentship of A. Karpinsky, Director of the Russian Geological Committee. The actual meeting was held in the large hall of the Zoological Museum on the 29th August (17th Aout according to the Julian calendar then used in Russia).[6] The invitation had been given at the Zurich (1894) session in the name of the Tzar Alexander II and the delegates were welcomed by the Grand Duke Constantine on behalf of the Tzar Nicholas II who granted free first class travel in Russia to all the delegates attending the 1897 session.[7] C. L. Griesbach had been recommended as the official delegate from India, but was unable to attend the Congress. F. R. Mallet and Philip Lake who had retired from the Geological Survey of India, were present at the meeting in St. Petersburg and the former had already attended the excursion to the Urals before the Congress meeting. The other excursions before the Congress were to Finland and Esthonia then still part of Russia.[8] After the Congress there were excursions to the Caucasus, Asia Minor, the Black Sea and Crimea. Everywhere the delegates received a hearty welcome, receptions by local authorities, numerous lunches and banquets of the most lavish description. According to some of the visitors, the social functions took too large a share of the time of the excursions.[9]

The discussions at the Congress were largely confined to (1) the adoption of definite principles for the classification of rocks and for petrological nomenclature generally; (2) the establishment of rules to govern the introduction of new terms in stratigraphical nomenclature; and (3) the conclusion that it was better to maintain a stratigraphical classification on an artificial basis until more data were available to establish it on a natural basis.

Since many of the excursions of this Congress were to form the nucleus of those conducted in 1937 it is of interest to record that pamphlets were issued to assist the delegates. The general descriptions and geological sections were good and satisfactory but there was some criticism regarding detailed particulars and that some mine sections did not correspond with visible exposures. In the case of the Urals excursion the journeys included a trip on the Volga at the famous Samara bend and visits to the limonite mines of Bakal, the works at Simsk, the magnetite deposits of Wyssokaia and Blagodat (near Nizhny Taghilsk); the famous malachite occurr-

[6] The Soviet Government adopted the Georgian calendar as from February 14, 1918.

[7] Nicholas I invited Murchison to examine the Donetz coalfield and the Urals region. Nicholas II was the Tzar who abdicated in March 1917.

[8] Both these areas had been seen by Strangways in 1822 and Murchison in 1841.

[9] Charles Palache (*American Naturalist*, November 1897, p. 954). Among other papers referring to this Congress see also *Am. Jour. Sci.*, 1897, **4**, 477; *The Mining Journal*, 1897, **47**, 1162; and *Nature*, 1897, **56**, 104.

ence of Mednorondiansk; the platinum placer of Platina; the gold washings of the Miass area; the gold veins of Beresof; and then the return *via* Perm and a steamer trip down the Kama to the Volga and up to the old Tartar town of Kazan. At that time the Russian Geological Survey (Committee) had a cadre of about 20 geologists and budget allowance of barely £20,000 which was more than that of the Geological Survey of India but not so well provided for. We had published a paper by J. B. Mushketoff[10]—'The Geology of Russian Turkistan'—in our *Records* and a few years later were to publish another by Th. Tchernychev[11]—'The Upper Palæozoic formations of Eurasia.'

Paris Exhibition Meeting, 1900.

The *Eighth* Session of the International Geological Congress was held at the time of the Exhibition in Paris in 1900 with Albert Gaudry as President. The veteran Dr. Blanford represented India. Professor J. Joly read his paper 'The Age of the Earth by the Sodium in the Sea' at this Congress. The subject of stratigraphical classification still continued to receive attention and such terms as *Era* (*e.g.*, Palæozoic), *Period* (*e.g.*, Carboniferous), *Epoch* (*e.g.*, Mid Devonian), *Age* (*e.g.*, Bartonian) and *Phase* (= Zone, *e.g.*, *Productus horridus*) were evidently widely used as the time equivalents for Group, System, Series, Stage and Zone, respectively.

The *Ninth* Session was held in Vienna in 1903 under Emile Tietze as President. C. L. Griesbach, late Director of the Geological Survey of India, and the late T. D. La Touche were present as the representatives from India. Griesbach read a paper on the Exotic Blocks of the Central Himalaya (Chitichun and Balchdhura) in which he supported von Krafft's theory of 'carriage' by lava floods than that of a possible development of over-thrust phenomena. T. L. Walker and C. Diener, who had both been into the area discussed, were not in agreement with the views put forward by Griesbach. La Touche considered the ideas of Klippen and Nappes put forward at the meeting—by Von V. Uhlig (Uber die Klippen der Karpaten), W. Killian (Les phenomenes de Charriage), Maurice Lugeon (Les grades Nappes de recouvrement den Alpes Suisse) and Arthur Keith (Fold Faults of the South Appalachians)—were of local geological interest though they attracted considerable attention at the meeting. There was also an interesting paper on the 1902–03 Eruptions of Mt. Peleé, Martinique, and the Soufriere, St. Vincent, by E. Otis Hovey.

The Tenth Session of the International Geological Congress was held in 1906 in Mexico City under José G. Aiguilera as President. We sent no delegate to this Congress. There were excellent papers by Dr. Tempest Anderson on the 'Recent Eruptions in the West Indies, St. Pierre (Mt. Peleé)' and 'The Eruption of Vesuvius'; and by Edgeworth David, J. W. Gregory and E. W. Hilgard (on glacial climates, climatic variations and causes of climatic changes) and also by W. Lindgren (on the relation of ore deposits to physical conditions).

Stockholm Meeting.

The *Eleventh* Session was held in Stockholm in 1910 with G. de Geer as President. After reconsideration the Government of India sanctioned the deputation of Dr. L. L. Fermor as the representative from India. His report[12] is published in our *Records*. Dr. G. E. Pilgrim put up a note on the climatic changes in India (due to the Pleistocene glaciation) for the Congress. The chief objective of the Congress was the preparation of a *Summary on the Iron Ore Resources of the World*. This was published subsequently and includes the information put together by La Touche and a note by Sir Thomas Holland. The importance of economic geology at these Congress meetings may be taken as recognised at this Stockholm session. Among other valuable contributions were papers on the 'Iron of Ovifak and Native Carbon' by C. Benediks. 'The Experimental Investigation of the Flow of Rocks' by F. D. Adams, 'A Criticism of the Quantitative Classification of Igneous Rocks' by W. Cross, and a brief note by C. R. Van Hise on 'The Influence of Applied Geology and the Mineral Industry upon the Economic Development of the World'.

Canada, 1913.

The *Twelfth* Session of the International Geological Congress was held in Toronto in 1913 with F. D. Adams as President. L. L. Fermor was again selected as the official delegate and represented India at the meeting. Sir Thomas Holland, who was also present, contributed an important paper on the Archæan and Purana Groups. A. F. Molengraaff also sent a valuable paper on 'Folded Mountain Chains, Over-thrust Sheets and Block Faulted Mountains in the East Indian Archipelago'. M. S. Maso and W. D. Smith's contribution on the 'Relation of Seismic Disturbance in the Philippines to the Geological Structure' was also of great importance. They showed that (1) there was a relationship between seismic disturbances and geological structure, (2) the majority of earthquakes are of tectonic origin in the Philippines region at least, (3) Volcanoes are secondary phenomena, and (4) the area of greatest seismicity in the Archipelago is in the Agusam valley, Mindanao. The chief objective of this Toronto session was the preparation of a *Summary on the Coal Resources of the World*, towards which Sir Henry Hayden, Director, Geological Survey of India, contributed the information from India and the adjacent countries. Finally, the meeting considered the question of a geological map of the world on a scale of 1 : 1,500,000—the same as that of the geological map of Europe—put up by Em. de Margerie. It was suggested that the six Asiatic sheets should be prepared by the joint efforts of the Geological Surveys based on Calcutta and St. Petersburg. Then came the War and no sessions were held till 1922.

Sessions after the War of 1914–18.

The *Thirteenth* Session of the International Geological Congress was held in Brussells in 1922 with J. Lebacqz as President. Dr. (now Sir)

[10] *Rec. Geol. Surv. India*, 1887, **20**, Part 3.
[11] *Ibid.*, 1904, **31**, Part 3.
[12] *Rec. Geol. Surv. India*, 1912, **41**, Part 4.

Edwin Pascoe was selected to represent India at this Congress which was important for the renewal of the exchange of views after nearly a decade. Among the more important contributions were papers by P. Bertrand (Geology of the Carboniferous), Charles Jacob (French Indo-China), L. Dudley Stamp (The Tectonics of Burma), W. H. Wong and A. W. Grabau (Carboniferous of China), H. Hausen (Physiographic development of the Sino-Siberian Continental Area), D. Mushketov (A Study of the Tian Shan) and David White (Public Geology and National Mineral Wealth).

The *Fourteenth* Session was held in 1926 in Madrid with Cesar Rubio as President. L. L. Fermor was again selected as the official delegate to represent India and visited Teneriffe on one of the excursions. Unfortunately, the collection of rocks and minerals which he made and despatched to India were lost when the M. M. Fontainebleau caught fire and was scuttled in Djibuti Bay where she still lies. Vulcanism was an important subject at this Congress, but there were also valuable papers on the Geology of the Mediterranean, the Geology of Africa, Thrust-faults in the north islands of the Adriatic, and problems of ore genesis. However, the chief effort to revive the economic aspect of the meeting was the preparation of a valuable compilation on *The World's Resources in Phosphoric Acid and Pyrites.*

SOUTH AFRICA, 1929.

The *Fifteenth* Session of the International Geological Congress met in 1929 in Pretoria with Dr. A. W. Rogers as President. Sir L. L. Fermor once again represented India and his great experience was of considerable value during the meeting to decide where the next session should be held. He had prepared a note on the Indian Goldfields as our contribution to the great objective of the Congress—the issue of a statement on *The Gold Reserves of the World.* While gold was perhaps the main theme of the session, careful consideration was given to a proposal to construct a Geological Globe of the world on the one hand and there was also no lack of interest in such valuable papers as 'The Karoo System' by A. L. du Toit and 'Rift Valleys' by J. E. Wayland, etc., on the other. After this meeting there was also an interesting communication by P. Kovaloff on 'The Reorganisation of the Russian Geological Committee'. It must be mentioned also that the invitation from the Soviet Government to have the next session in Moscow was submitted during this South African Session, and, on a claim of priority from the United States, had to be reserved for acceptance after the American Session.

WASHINGTON, 1933.

The *Sixteenth* session was eventually held in 1933 in Washington with W. Lindgren as President. We were unable to send a representative owing to the financial stringency which prevailed in India as elsewhere at that time. Sir L. L. Fermor, however, compiled a note on 'India's Copper Deposits' for inclusion in the brochure on *The Copper Resources of the World* which was to be the chief production of the Congress. As in the case of the earlier American Congress of 1891, perhaps the most attractive feature of the 1933 session, was the choice of interesting excursions to famous areas of geological importance. In the 42 years which had elapsed since the previous meeting in Washington the Geological Survey of the United States had steadily developed until it was recognised as the finest and best equipped organisation of its kind. Added to this was the knowledge that geological surveys were also organised by various States, and since a vast literature was coming from numerous geological and mining institutions, including the universities, it seemed that geology had proved itself to be one of the most important sciences in the minds of perhaps the most practical nation in the world. The International Geological Congress held in 1933 in Washington thus appeared to be most important of the sessions so far held. It did not matter very much where the next meeting would be held provided it was in a convenient place, and so a qualified invitation from London was considered until the offer from Moscow was renewed. It was then decided that the Soviet invitation was both of long-standing and cordial and so Moscow was fixed upon.

THE SEVENTEENTH SESSION HELD IN MOSCOW, 1937.

So much has happened in Russia during the last twenty years—since the Great October Revolution of 1917 when the Bolshevik regime definitely assumed control of the country—that a visit to the Union of Soviet Socialist Republics, under almost any circumstances, must be interesting. So much has been reported about the conditions in that country and so many claims have been made by Soviet geologists and other scientists in regard to their discoveries in the field and in the laboratory that foreign scientists were sceptical of these claims. In these circumstances my selection by the Director, Geological Survey of India, to go to Moscow as the representative of the Government of India to attend the Seventeenth International Geological Congress was most enviable, especially as I was the only delegate from India. In the previous Seventh International Geological Congress held in Russia, in St. Petersburg in August 1897, it happened that there was no delegate from India owing to some delay in the selection of a representative—Mr. C. L. Griesbach—who was unable to attend when recommended.

Before the Congress meeting on July 21st excursions had been arranged for visits to the north (Kola peninsula and Karelia), to the south (Ukraine and Crimea), to the Caucasus and to the Volga-Urals area (Permian excursion). After the Congress closed, excursions were arranged to visit the Petroleum occurrences, Siberia, Nova Zembla, and the Urals, in addition to places near Moscow. I attended the Permian excursion as it was closely related to the work I had been doing in India and was probably more palæontological than economic. In fact it was very soon evident that economic geology was the chief concern of the Soviet Government and the subject of mineral resources was the main theme of the papers and discussions at the meetings of the delegates in Moscow, in Leningrad and at the various places visited

during the excursion. It was a subject for complaint during the Russian meetings of 1897 that banquets played perhaps a more important part in the excursions than visits to exposures. We had nothing to complain against the excursions except that some were long days, nor can we say that banquets were too few for we were treated generously everywhere—from picnics in a Bashkirian forest to a banquet in the Kremlin itself. We found the U.S.S.R. to be a geologists' paradise. Nothing seemed to be done in mineral prospecting, the development of mines, the exploration of oil-fields, the erection of metallurgical works, the construction of canals and other engineering structures, and even in the reclamation of lands, without the opinion of the geologists engaged in that district or in direct consultation with the geological authorities in Leningrad.

Each mineral industry—gold, coal, petroleum, salt, mica, phosphates, etc.,—has its own so-called Trust which may have branches all over the U.S.S.R. There is exploration everywhere and mineral and metallurgical works are in course of erection in various parts of the vast territories of the U.S.S.R., which are equal to half the area of Asia and fully four times that of India—yet with a population only half that of India. We were almost bewildered by the immense activity we saw wherever we went throughout the length and breadth of Russia, and it is not too much to say that the enthusiasm of those engaged and their intense pride in all their work showed that a nation had been established and is going forward. Our unbelief in the vast claims slowly disappeared as we travelled and met geologists almost everywhere and saw their maps, their mines, their technical schools and colleges. Somehow it was no shock to us when we learned that over 10,000 geologists were engaged on State surveys or in the Trusts or in Universities and other scholastic institutions. Their equipment is not equalled in India, their museum collections (especially those in Leningrad) are splendid and well housed, their research laboratories are lavishly supplied and their work is equal to any geological work. In physics and chemistry, in geo-chemistry and geo-physical work they have little to learn from other countries. In fact it is difficult to express in words the high standard of the work—whether it be connected with the atomic structure of elements, the study of crystal structure, the synthetic production of minerals, the investigation of mineral associations in ore deposits or pegmatites, or palæontological and palæobotanical determinations—that is being steadily and carefully done in numerous centres.

It may be said that the scientific standard of work is set by the Institutes controlled by the Academy of Sciences, while the efficiency of geological work—mapping, mineral study, etc.,—is guided by the Geological Survey Committee and the Central Geological and Prospecting Institute for Scientific Research (TsNIGRI) in Leningrad. It must not be concluded that a geologist is free to do research work at his own time all the days of his life. This is not the view of the Academy and Survey authorities who are responsible to the Soviet Government from whom the generous grants are obtained for scientific research, expeditions, surveys, prospecting and for exploration and development. The mineral resources of the U.S.S.R. have not only to be found, studied and estimated, but must supply the needs of the country's industries. With all land and minerals belonging to the people, under the control of the Government, nationalization of industries is a fundamental matter and so a great deal can be done to coordinate development. It is the policy of the Government to make each Autonomous or Union Republic dependent on its own mineral resources for its industrial wants. Consequently geological search is widespread through the U.S.S.R. Geologists vie with each other to make discoveries and, as may be imagined, subject each other's discoveries to severe scrutiny. It is not wise to claim more than you can justify and there is little place for a geologist lacking energy—the expenditure on his training must be justified either by hard work or great ability.

The point of the Seventeenth International Geological Congress was to show us that Russia is second to none in geological work and we must admit that they have proved all their claims and congratulate them for showing the value of the geologist to their Government.

Weather Prediction.

UNDER the auspices of the National Institute of Sciences of India, a Symposium on Weather Prediction was held in the Meteorological Office, Poona, on the 25th and 26th July, 1938. Various aspects of forecasting of weather were discussed at the Symposium, attention being focussed mostly on the problems facing the Indian meteorologist and the proposed or attempted methods of solution. Thus, papers presented at the meeting concerned long-range forecasting for a whole season as developed in India, medium range forecasts for 10-day periods as developed by the German and Russian Schools, short-range, *i.e.*, day-to-day, forecasting in India with special reference to the use of air mass analysis in this task, the use of upper air data in weather forecasting, thermodynamic studies of the atmosphere with special reference to latent instability, rainfall in north-west India associated with winter disturbances, weather forecasting for aviation and the application of kinematical methods to forecasting.

In his opening remarks PROF. M. N. SAHA, the President of the Institute, referred to the fascination which the art of weather prediction held out to man from the earliest times, to the development of the synoptic chart in this country from the time of Blanford and Eliot and to the subsequent contributions made by the Indian meteorologists to the art and science of weather prediction.

DR. C. W. B. NORMAND welcomed the visitors

to the Symposium on behalf of the Meteorological Department and reviewed briefly the complexities of the problems which faced the meteorologist. At one time, it was sufficient for the forecaster to restrict his attention to rainfall alone. Now the conditions had altered largely; the meteorologist had not only to forecast for storms over the sea and land but had to warn the airman who wanted detailed forecasts of upper winds, of height of clouds, of fog, dust-storms, squalls, etc. A variety of requirements had thus to be satisfied and yet his decisions had to be made quickly. There was no time for lengthy calculation such as would be necessary if he desired to, and could, write complex mathematical equations relating to the weather situation at any instant and solve them to obtain the picture at a future instant. The most hopeful method from the practical point of view appeared to be to focus attention on the identification of air masses, homogeneous within themselves, and to the effects which a mutual interaction between the several air masses would produce. India was the country in which most attention had been paid to the subject of seasonal forecasting and yet, the most that we could do to-day was to give a very general indication of total rainfall over large tracts of the country for a period of two to four months. Dr. Normand concluded by giving a brief general survey of the different aspects of the problem which was to be dealt with in detail by the subsequent speakers.

Dr. S. R. Savur told the story of seasonal forecasting in India. The first forecast of monsoon rain, mainly based on the data of snowfall on the Himalayas and the Sulaiman range during the preceding January to May, was issued by Blanford in 1886. Eliot who succeeded Blanford added other factors like the southeast trades at Mauritius, Zanzibar and Seychelles, data of south Australia and Cape Colony and " Nile Flood ". But in his method which was mainly graphical, there was much chance of individual bias. A great improvement in foreshadowing monsoon rainfall resulted when Sir Gilbert Walker introduced the more impersonal method of correlation coefficients in place of Eliot's graphical method. The first forecast using a regression equation was issued by him in 1909. In 1924, he worked out six formulæ for forecasting rain in the Peninsula, northeast India and northwest India in which use was made of some 28 factors selected out of a large number after applying the statistical test. now named after him. Mr. Field, the pioneer of upper air work in India, was responsible for suggesting a new factor of special interest, as he was the first to make use of upper air data in seasonal forecasting; his factor is the upper winds of Agra in autumn, to foreshadow the winter rains in northwest India. The re-examination of the data in recent years and the application of the Performance Test showed a diminution in the significance of some of the factors. Nevertheless the total correlation coefficient is still found to be 0·63 for total monsoon rainfall of the Peninsula and 0·64 for that of northwest India and 0·72 for the winter rains of northwest India. The seasonal forecasts issued at present are for (i) the winter rainfall during January to March in northwest India, (ii) the monsoon rainfall during June to September in northwest India and the Peninsula and (iii) the monsoon rainfall during August and September in the same two divisions. Efforts were being made to decrease the period of the forecasts and also the area which they covered. Dr. Savur emphasised that methods of correlation were strictly applicable only when all the quantities correlated varied according to the normal law of distribution. To overcome the handicap introduced by non-normality of distribution found in practice, general methods were being developed but the work was still in its initial stages.

Coming to medium range forecasting, Mr. S. Basu explained the method developed by Franz Baur of the German Meteorological Service for forecasting for 10-day periods, a method which depended on a suitable combination of statistics and synoptics. He also explained the composite map method of forecasts developed in Russia by Multanovsky and his collaborators in which the time interval for the forecast was dictated by the prevailing weather situation, each type of synoptic system having its own characteristic persistence. Mr. Basu briefly discussed the possible application of these methods to Indian conditions.

Dr. S. N. Sen explained the methods adopted in daily forecasting practice for identification of air masses which, broadly speaking, fell into two classes, oceanic and continental, but could be subdivided into several sub-classes. He illustrated by means of charts certain types of stationary fronts which often developed over the Indian area. He also showed how use was made of stream lines and convergence patterns of air currents aloft deduced from pilot balloon data and cloud movements, along with a knowledge of upper air climatology for identification of air masses and day-to-day forecasting.

Dr. Pramanik spoke on the application of air mass analysis to the problem of forecasting nor'westers in Bengal.

Dr. K. R. Ramanathan gave a brief review of the development of upper air work in India and explained how the data helped the issue of forecasts relating to conditions on the ground as well as in the upper air. The data provided the basic information regarding the climatology of the upper air and helped intensive studies of the structure of atmospheric disturbances. He gave a few instances of the use of these data in such studies. For instance, he showed how warm fronts somewhat similar to those in European latitudes were found to be associated with storms and depressions in the Bay of Bengal. The two air masses between which the front formed were the dry cold air from northern India and the moist equatorial air from the south Bay. A modified type of front was associated with the storms of the premonsoon season. In monsoon depressions the main front formed between fresh monsoon air and old monsoon air, the former behaving as a cold mass and the latter as a warm mass. Dr.

Ramanathan also showed a picture of the general circulation of the atmosphere over India as obtained from pilot balloon ascents made for the past few years in this country.

The role of latent instability in the atmosphere formed the subject of an interesting communication by Dr. N. K. Sur; in the absence of the author the paper was presented by Dr. R. Ananthakrishnan. The term 'latent instability' which was defined by Normand in 1931 referred to a thermodynamic state of the atmosphere in which, under suitable circumstances, the initial expenditure of a small amount of energy led to the release of a much larger amount of energy. Absence of latent instability was ordinarily associated with dry fine weather with occasionally high clouds of the non-convectional type, while its existence was associated with convective clouds or instability phenomena like dust- or thunder-storms. Interesting series of soundings taken during the formation of storms in the Bay of Bengal and their movement showed the progressive building up of latent instability conditions as a disturbance approached the station and its disappearance as it moved away or dissipated.

Mr. S. P. Venkiteshwaran read an interesting paper on rainfall due to winter disturbances and the associated upper air temperatures over Agra.

Dr. S. K. Pramanik spoke on the use of upper air data in day-to-day forecasting and illustrated his remarks by charts.

Mr. P. R. Krishna Rao discussed the problems which demanded attention in weather forecasting for aviators which could be divided into three categories: (i) regional, (ii) route, and (iii) local. In regard to local forecasting he explained the use being made at Karachi of tephigrams of aeroplane ascents in forecasting local convectional phenomena and formation, persistence or clearing of clouds. The soundings by aeroplanes had afforded a valuable aid in this task. He also referred to the question of fog forecasting and remarked how the Taylor Diagram had not proved very successful except in ruling out days when fog was unlikely.

The use of kinematical methods in weather forecasting as developed by Dedebant and Pettersen was explained by Dr. S. K. Banerji. Whenever any pressure system, such as a cyclone, an anticyclone, a trough or a front was in continuous motion, one could from a knowledge of the changes in the 2 to 3 hour period preceding, calculate the velocity and acceleration of each point of the system and foretell the position and configuration of the system during the next 6 to 12 hours. The deepening or filling up of pressure over an area bounded by two closed isobars was equal to the planimetric value of the barometric tendency within the same area. Dr. Banerji illustrated an application of these and other kinematical laws to certain Indian storms, particularly to explain the curvature of the tracks of the storms.

Lively discussion took place at the end of each of the papers mentioned above.

Dr. Norman who wound up the discussion referred to the future of weather forecasting. He felt doubtful whether any statistical methods applied to surafce data alone would result in much further advance in seasonal forecasting. Here as well as in other branches of forecasting we had to look to the upper air for further improvements in our forecasting capacity. There lay our hope. More data of soundings of the atmosphere by aeroplanes, radio-sondes or balloon meteorographs were needed for day-to-day analysis of the conditions in the upper air which alone would help us to understand the mechanism that was behind the making of weather.

The proceedings terminated with a vote of thanks to the President proposed by Dr. Normand after which two cinematographic films illustrating the evolution of clouds were shown to the audience.

"Ascu"—A Wood Preservative.*

It is but some five years since "Ascu"—a patented timber preservative treatment—first appeared on the market. A considerable amount of work, both in India and abroad, has been done on the merits and limitations of the method. In 1933, at the instance of the Railway Board, a distinguished Committee enquired into the suitability of this (and of the Falkamesam) process for treating Railway timber, principally of sleepers. Their findings were published in a Report in which they indicated several lines in which further work was desirable. This mass of literature is apt to bewilder the layman who is not always able to view scientific data in true perspective. Meanwhile, in India, preservative timber treatment is just beginning to win general recognition as part of the normal technique in modern timber utilisation. Therefore, in the interests of the individual user as well of the healthy development of timber utilisation in the country, it is opportune that this authoritative publication has appeared.

A general introduction in the book is followed by a summary of the results of tests with "Ascu". In the third chapter is to be found simple and unambiguous instructions, with the aid of diagrams, of the three methods of using Ascu—brush treatment, dipping treatment and pressure treatment. The detailed data on the "Ascu" tests are set out in ten tables, the last one dealing with tests conducted out of India. The prices at which "Ascu" could be bought in bulk and in

* "*Ascu.*—A Wood Preservative (*Indian Forest Records*, New Series, Utilisation," Vol. I, No. 6). By the Forest Research Institute, Dehra-Dun. Pp. 143–87. Price As. 14 or 1*sh.* 6*d.* Delhi, 1938, published by the Manager of Publications,

smaller quantities are given in an Appendix. The inferences which all these data warrant are assessed by the Forest Economist, Captain H. Trotter, in a *Foreword* written with the scientific detachment appropriate to such a publication. It is a great merit of this book that it emphasises again and again that the data are all indicative rather than conclusive. One is apt to overlook that it is a hundred years since pressure creosote treatment was patented by John Bethell; equally old is the zinc chloride method. And still, to-day after all these years, the last word on these processes has by no means been said. "Ascu", but five years old, is thus still in its infancy, and as this book shows, a very promising infancy with every indication that it will stand the test of time.

This very useful publication should appeal to everyone interested in timber preservation. Its value to the research worker would have been even greater by the inclusion of two more appendices—one giving the exact terms of the patent specifications of "Ascu" and another, a bibliography of the literature that has appeared on "Ascu" to date.

EMMENNAR.

The Geological Survey of India.

THE General Report of the Geological Survey of India for the year 1937 just published by the Director Dr. A. M. Heron, is an impressive record of the large volume of work done by the officers of the Department during the past year. During the field season, most of the officers were out on geological survey work mapping in great detail areas of special interest in different parts of India. In the North-East Circle, Dr. Fox and his associates were engaged in surveying the Garo Hills and the Khasi and Jaintia hill districts of Assam. In the North-Western Circle, Dr. Coulson spent some time in Waziristan and made valuable observations having an important bearing on the geology of parts of north-western India. Mr. W. D. West completed his mapping of the Shali area and worked out in detail the structural features of this part of the country. As regards the age of the Shali limestone, Mr. West thinks that its correlation with the Krol limestone cannot be regarded as certain. It is probable that the two series are of the same age but this cannot yet be asserted on definite evidence. In the Southern Circle, Mr. H. Crookshank and Dr. P.K. Ghosh devoted a considerable amount of time to mapping in the Bastar State, as a result of which several interesting observations have been made. According to Mr. Crookshank, the banding of the hematite-quartzite in this area has probably nothing to do with the original stratification of the rocks, but is due to the deposition of iron ore along the planes of cleavage or schistosity of the original ferruginous phyllites or slates. Dr. Ghosh has recorded several phenomena indicating assimilation and hybridisation in the granitic rocks of this area.

In addition to this extensive Geological Survey work, the Department has also found time to assist the general public in connection with the large number of economic enquiries from all over India, regarding the occurrence and possible development of various kinds of mineral deposits. On Engineering and allied questions, especially water supply, the opinion of the geologists of the Survey has been frequently sought not only by private individuals but also by local and provincial governments, and on every one of these occasions, the Department has readily given authoritative and expert advice with commendable willingness. In the Elephanta Caves near Bombay, which are a well-known treasure-house of ancient figures and sculptures of great archæological interest, it is noticed in recent years that there has developed a tendency for the rocks of these sculptured figures to decay and crumble gradually due to natural processes of weathering during the long period of nearly 1400 years during which they have been in existence; and the Government of India recently appointed a Committee to go into this question and suggest the measures to be taken to combat this; and on their request, an officer of the Geological Survey of India—Dr. M. S. Krishnan—was deputed to advise the Committee on the geological aspects of the matter. Dr. Krishnan has investigated this problem thoroughly, and in his Report to the Director-General of Archæology, has made valuable suggestions for the prevention of such decay and disintegration.

The Department is also anxious to educate the layman in geological matters and stimulate in him a general interest in the geology of his country; and with this object in view, attempts are being made to reorganise the Museum so as to make it more attractive and instructive,—an important new feature being the preparation and display of descriptive labels in the several common Indian languages like Hindi, Bengali and Urdu, to enable the public to understand and appreciate the several exhibits. In the Palæontological Section, considerable work in this direction is being done by Dr. M. R. Sahni, under whose direction the fossil galleries have been entirely rearranged and illustrated with restoration drawings of some of the more interesting genera. Notable amongst these are the serial wash drawings illustrating various stages in the evolutionary history of such interesting animals as the Elephant, the Horse, etc.

To those who are frequently inclined to doubt the utility of geology and geologists in public service, a perusal of the present Report gives a good idea of what a well-organised Geological Department could do for promoting the progress and prosperity of a country.

GEO.

The Krishnan Effect.

In a series of papers published in the *Proceedings of the Indian Academy of Sciences* (1934–38), Dr. R. S. Krishnan working in Sir C. V. Raman's laboratory at Bangalore has demonstrated the existence of a new effect referred to by Prof. Gans in a paper in the *Physikalische Zeitschrift* (1936), **37**, 19, as the "Krishnan Effect"—relating to the state of polarisation of the light transversely scattered by certain liquid and solid media. If the incident beam of unpolarised light passing horizontally through the medium be regarded as made up of two beams of equal intensity and unrelated in phase, one with vibrations vertical and the other with vibrations horizontal, the light scattered in a direction normal to the incident beam can be supposed to be made up of four components V_v, H_v, V_h and H_h, the first two arising out of the vertical component and the last two arising out of the horizontal component of the incident beam. The first important observation of Dr. Krishnan which is general in its application is that $H_v = V_h$, whatever be the nature of the scattering medium. This he has called as the *reciprocity relation*. The second fact experimentally observed by Dr. Krishnan is that the depolarisation factor $\rho_h = V_h/H_h$ is less than unity in a large variety of material media, such as critical solution mixtures of liquids very near the critical solution temperature, colloids and optical glasses. In pure liquids it is known that $P_h = 1$ and the above observation signifies that in cases where p_h is less than one, the scattering units are no longer small compared with the wave-length of the incident light. Soon after the publication of his results on molecular clustering in binary liquid mixtures, Prof. Gans put forward a theoretical explanation of the observed anomalous depolarisation (*i.e.*, $p_h < 1$). He finds that the Krishnan effect requires the existence of optically anisotropic clusters which are strongly non-spherical in shape. In a later paper (*Phys. Zeit.*, 1937, **38**, 625) however he has questioned the validity of the reciprocity theorem.

Recently in the *Proceedings of the Royal Society*, 1938, **166**, 425, Dr. Hans Mueller has theoretically discussed Dr. Krishnan's investigations and has completely confirmed the validity of his conclusions from very general theoretical considerations. He has derived the reciprocity relation and has shown that the objections raised by Prof. Gans are not valid. Based on Dr. Krishnan's work he has also put forward the theory for the structure of optical glasses. The theoretical considerations of Dr. Mueller upholds the view put forward by Sir C. V. Raman in *Nature*, 1922, **199**, 138, that the intense scattering of light in optical glasses is molecular in origin and is an inherent property of the amorphous state of matter. It is remarkable to find that the magnitudes of the Krishnan effect observed in optical glasses follows very closely the order predicted by Dr. Mueller in his paper.

The new method of experimental observations of the scattered light developed by Dr. Krishnan and the principal results emerging therefrom described above have opened out a wide vista of applications in the study of colloidal systems and the amorphous state of matter. Dr. W. Lotmar has made a general survey of these investigations in the current number of the *Helvetica Chemica Acta*, 1938, **21**, 792.

SCIENCE NOTES.

George Ellery Hale (1868–1938).—Dr. George Ellery Hale, who died on February 21, was by common consent the "greatest builder of modern astronomy". When he was only 22 years old, he established with his father's financial aid, the Kenwood Astrophysical Observatory, where he invented the spectroheliograph. In 1892, with the munificence of Charles T. Yerkes, he was enabled to found the Yerkes Observatory with its 40-inch telescope which is still the world's largest refractor.

In 1904 the Mount Wilson Observatory was established through the efforts of Dr. Hale. The Observatory, perched on the mile-high peak, was essentially meant for solar observations. In 1914, Dr. Hale obtained from John D. Hooker, a sum of $ 45,000 for a 100-inch telescope disc and with the help of the Carnegie Foundation, the giant telescope was completed and mounted in the Observatory. Dr. Hale retired in 1923 owing to failing health but pursued his researches in his private observatory at Pasadena. Here he invented the spectrohelioscope. In April 1928, he published in *Harpers's Magazine*, an article, wherein he indicated the need for, and the practicability of, a 200- or even a 300-inch telescope for astronomical research. The 200-inch telescope is now in the process of being built and it is hoped that by 1940 the instrument will be completed and mounted in the new Observatory on Mt. Palomar, as a monument to the memory of George Ellery Hale.

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The American Museum of Natural History, The Sixty-Ninth Report of the Museum for the year 1937, gives a succinct account of the activities of what, by reason of its collection and scientific staff, may be considered the largest organization of its kind in the world. This great educational institution has an 'Exhibition area of 23 acres, collections on exhibition and available for study valued at over $ 30,000,000 and a force of approximately 451, who are paid in round figures $ 1,000,000 a year in salaries to carry on the work'. The scientific and educational work comprise expeditions, purchase of collections, preparation of exhibits, changing old exhibits and developing new ones, publication and research by the scientific staff. In an introductory note to the Report, President Fredrick Trubee Davison draws attention to the serious financial condition

of the Museum. In the year 1936, a $ 10,000,000 Ten Year Development programme was announced, which was definitely organised in the year 1937. The response by hundreds of friends of the Museum was most gratifying. In order that the American Museum of Natural History may foster its functions, ' it must not stand still. It certainly must not retrogress. It must go forward '.

In spite of the declining income and resulting curtailment in many of its most important activities in scientific research, the amount of original work turned out by the staff of the Museum is impressive both in regard to quality and volume.

It would hardly be possible to do any justice to the numerous activities of the Museum in a brief note. Among the recent exhibits, mention must be made of the Haydon Planetorium, now in its third year of operation, which 'holds a unique place among educational institutions of our great city, for here the science of Astronomy is made a fascinating study to even the youngest visitors. And apart from its educational value, it continues to present a form of entertainment that gives the visitor a never-to-be-forgotten experience of insipration and beauty '. In the section devoted to exhibits in ' minerology ' a number of interesting additions were made. Mention may be made of a large rock crystal sphere mounted on a tall pedestal, beneath which is placed a device consisting of rotating discs of coloured glass, throwing a cycle of colour combination through the quartz sphere which acts as a ' cosmic colour mixer '. The effect of the introduction of the ' crystalight ' has been to double the attendance in the Morgan Hall, in which this exhibit has been housed. New exhibits were also added to the section in Vertebrate Palæontology, Geology, Living Invertebrates, Entomology, Ichthyology, Herpetology, Ornithology, Mammalogy, Anthropology, Comparative and Human Anatomy and Experimental Biology. In the last-named section the Theodore Roosevelt Memorial Hall has been transformed into one of the most interesting exhibits in the Musuem. " Hardly a day goes by without some visitor to the Museum wanting to know why certain animals behave in particular ways. The mechanisms regulating the behaviour of animals and men are fairly well known ; but no museum has until now attempted to show that various mechanisms in the form of a well-rounded exhibit. The chief reason for this is that behaviour is dynamic, requiring exhibits with parts which move when the visitor presses a button.' Exhibits of this type can fascinate the public while telling a serious scientific story. There are other dynamic exhibits telling the story of the animal mind. With the help of a group of artists, sculptors, and technicians, a series of exhibits have been built up showing the ' world as seen through the eyes of a dog, hen, trout, snapping turtle and house-fly '.

The contrast is obvious between such wide museum activities and what is possible in the understaffed and inadequately financed musuems to which we have grown accustomed in India. The need for a permanent Expert Committee to deal with the situation is urgent.

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Mysore Geological Department.—In the first few pages of the latest *Records of the Mysore Geological Department* (Vol. XXXVI, 1937) recently published, Mr. B. Rama Rao, Director, gives a general report of the work of the Department during the year 1936–37, under several headings such as Administrative, Mining and marketing of minerals, Geological survey, Mineral-surveying and prospecting, Engineering and water-supply questions, etc., and in all these sections the work done by the officers of the Department is of a kind which will be highly appreciated both by the Government and the general public. In addition to the investigation of special problems connected with the useful aspects of geology on the economic and engineering side, about which a number of short reports have been published, the *Record* includes a notable contribution on the purely scientific side—a paper on—"The Cordierite Hypersthene granulites and their associated schistose rocks from Bidaloti, Mysore State " by Messrs. B. Rama Rao and T. P. Krishna Char. In the Bidaloti area, which is less than a square mile in extent, occurs a complex and highly metamorphosed suite of rocks comprising such interesting members as hornblende granulites, pyroxene granulites, cordierite hypersthene granulites, sillimanite quartzites, etc. The complicated geology of this area has been thoroughly worked out and the rocks examined in detail. Of these, the most interesting are the cordierite hypersthene granulites ; and from a complete study of their mineralogical, chemical and field characters, the authors have come to the conclusion that these rocks were originally true sediments, their present condition being due to repeated cycles of metamorphism by different igneous intrusions, which have also materially affected their chemical composition. It will be remembered that it was from these cordierite hypersthene granulites that a new orthopyroxene was recently described by Mr. B. Rama Rao in collaboration with Prof. L. Rama Rau of the Central College.

The activities of the Department during the year under review were many and varied ; and we have no doubt that under the enthusiastic guidance of its present Director the work of the Department will continue to expand both in its scope and its usefulness. GEO.

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The Third Report of the **Royal Institute of Science,** Bombay, covers a period of three years (1934–37) and constitutes an interesting and valuable document from several points of view. Of significant interest is the volume of original work carried out at the Institute by the members of Staff and their associates, although burdened with teaching and administrative duties. Professor Wheeler and his colleagues in the Department of Chemistry are responsible for about 65 per cent. of the output. Abstracts of the 94 lines of research in progress in the four Departments of Physics, Chemistry, Botany and Zoology are given in the Appendix, and these are helpful to workers in other parts of India in avoiding wasteful duplication. It should be a matter of pride for the Institute that only 3·6 per cent. of its post-graduate students for the period 1925–37

remain unemployed. Writing about "Future Progress", the Report adds : "A satisfactory volume of research output has been attained. *Improvement, however, is to be sought in the quality of the research work.* To do this it is essential to attract good students to stay on after they have gained the M.Sc. degree, and work for the Ph.D. This has proved unexpectedly difficult ; as will be seen from Appendix F, practically all the M.Sc. graduates obtained posts, and although a number of those with employment try to do part-time work for the Ph.D. degree, experience has shown that progress with part-time work only, is slow and erratic. Post-M.Sc. scholarships do not completely solve the difficulty. It has been the experience of both the Institute and the University that students holding such scholarships will surrender them willingly and if necessary refund the money paid to them if they are offered a post. *A good deal of time and money is wasted on such students who leave with little notice in the middle of a piece of planned research. Students appear to enter for Ph.D. work merely to fill in their time until they obtain employment.* As employers come to realise the value of higher degrees and suitably reward the possessor of a Ph.D. degree, the position will probably improve." This statement holds good in the case of other institutions as well. We wish other Universities and research institutes in the country issue their reports on this model. It may perhaps be worthwhile for the Inter-University Board to discuss this matter and arrive at some uniformity in issuing periodical reports of the various research centres in the country.

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The **Annual Report of the Imperial Dairy Expert,** for the year ending June 1937, embodies the first year's activities after the separation of the Office of the Dairy Expert from the Imperial Agricultural Research Institute, New Delhi, and made an independent unit under the direct control of the Government of India. During the period under report, there was a remarkable manifestation of public interest in the Dairy Industry as evidenced by the large number of requisitions received for help and advice in starting dairy farms, foundation herds for breeding pedigree stock, etc. The Appeal issued by H. E. the Viceroy of India for the improvement of the cattle-wealth of the country and the holding of the All-India Cattle Conference at Simla (May 1937), have served to focus public attention on this nation-building industry. During the year Dr. Wright visited India, at the invitation of the Imperial Council of Agricultural Research, to conduct a survey of the Dairy Industry in India and make recommendations for its proper development.

During the past few years the Dairy Industry has made great progress. In his introduction to the Report, the Imperial Dairy Expert has compared the state of the industry to-day with what it was two decades ago when " except for the work done in the Military Dairy Farm with the special object of meeting the demands of British Troops, the industry in general, was in a morbid condition ". To-day, the condition is different ; the public have begun to realise that the industry is of vital importance to the country and attempts are being made to develop the industry on scientific lines. The Imperial Dairy Expert received no less than 25 enquiries for information regarding the manufacture of products like casein, condensed milk, milk powder and ghee on a factory-scale. Enquiries were also received from butter manufacturers for special cultures for improving the quality of butter. There is also an increased demand for training in Dairying. All these are encouraging signs which go to show that the future of the Dairy Industry in India is assured.

The Imperial Dairy Expert has, under his administrative control, the Imperial Dairy Institute, Bangalore, and the affiliated centres at Wellington and Anand. The Institute at Bangalore is the main centre of educational and scientific activities. The Milk Depot at Wellington is run purely as a commercial concern and the Research Creamery at Anand remains closed, pending the decision of the Government on Dr. Wright's Report.

The total number of students trained during the year is 55. In the laboratory, attention was devoted mainly to problems that have immediate application to the industry. Seven research papers were published during the year.

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We have been favoured with a mimeographed copy of **A Method for Preparing Palmyra Jaggery for Refining,** by Victor M. Hinchy of West Kensington, London, W.14. This subject is one of topical interest in view of the programme of prohibition which several of the provincial governments in the country have in view. Those interested in this topic may usefully get into touch with the author.

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Industrial Possibilities in the Tinnevelly District.—The Tinnevelly District Commercial Association has issued a 38 page brochure, dealing with some of the more important commercial possibilities offered by the agricultural, forest, marine and other natural resources of the District (*Some Possible Industrial Ventures in the Tinnevelly District*, by A. V. Varadaraja Iyengar, D.Sc., A.I.C.). As is the case with other parts of this country, we have " poverty in the midst of plenty ", an unfortunate circumstance which is largely due to the paucity of the Government and the public in utilising competent technical talent in exploiting the resources. The Tinnevelly District Commercial Association which has inspired the publication of this brochure, might also take up the responsibility of giving effect to such of the recommendations which may have the prospect of immediate success. This is a report which deserves the careful consideration of all those interested in the prosperity of the District.

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The Grading of Aggregates and Workability of Concrete.—In placing concrete, whether for roads or structures, a factor of the utmost importance is the control of the workability of the mix. To control the workability solely by variation of the water content may lead to a needless and uneconomic sacrifice of strength.

In a recent report (Road Research Technical Paper No. 5 ; H. M. Stationery Office, London),

it is shown that by adjusting the grading of the aggregates to fall within certain limits, it is possible for the engineer to obtain the best combination of workability and strength for his purpose.

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Forest Products Research Board for the Year 1937.—The work of the Forest Products Research Laboratory for the year 1937, is summarised in a recent report issued by H. M. Stationery Office. Descriptions of the investigations into the structure, seasoning and preservation of timbers, their working qualities, physical properties and chemical composition are also included in the Report. Among other important subjects discussed are laminated wood products and fibreboard packing cases. Typical examples are also given of the help afforded to industry and to the general public by the Research Board.

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Royal Institute of Science, Bombay.—Mr. D. V. Bal of the Zoology Department, has been awarded the Sir Mangaldas Nathubhoy Scholarship of the Bombay University for the study of Marine Biology in England.

The National Institute of Sciences, India, will hold a Symposium on "Recent Work on the Synthesis of Naturally Occurring Substances" at the Royal Institute of Science, Bombay, on the 26th and 27th September. The Vice-Chancellor will perform the formal opening. Prof. M. N. Saha is expected to attend.

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University of Mysore.—1. *Personnel*: (1) Miss M. C. Albuquerque, L.R.C.P., M.R.C.S., L.M., Lady Medical Officer, Vani Vilas Hospital, Bangalore, was appointed Principal, Medical School, Bangalore, *vice* Rajasevasakta Dr. B. K. Narayana Rao appointed as Senior Surgeon. (2) A Professorship for Applied Mathematics was sanctioned for the Central College and Dr. B. S. Madhava Rao was appointed to it.

2. *Meeting of the Academic Council.*—A meeting of the Academic Council was held on the 27th August 1938. Among the propositions that were passed, mention may be made of the following: (1) Re-instituting French as a second language and making provision for Latin also as a second language for the Intermediate, B.A., and B.Sc. examinations. (2) Providing the following additional group of optional subjects for the I.Sc. examination and the B.Sc. Pass Degree examination: Economics, Geology, Chemistry. (3) Scheme regarding the course of studies in Politics for the B.A. Honours degree examination. (4) Reducing the minimum for compartmental pass in the Intermediate Examination.

3. *Elections.*—(1) Mr. V. L. D'Souza, B.A., B.Com. (Lond.), Professor of Economics, Maharaja's College, Mysore, was elected to the University Council by and from the Academic Council *vice* Rajasevasakta Dr. B. K. Narayana Rao appointed as Senior Surgeon. (2) Sastravaidyapravina Dr. S. Subba Rao, B.A., M.B.C.M., etc., Retired Senior Surgeon, was elected as a member of the Mysore Medical Council *vice* Rajasevasakta Dr. B. K. Narayana Rao, by the Faculty of Medicine.

4. The Sri Krishnarajendra Silver Jubilee Lecture, 1938 (founded by Mr. V. Subrahmanya Iyer, B.A., Retired Registrar of the University) was delivered at Bangalore on the 27th August 1938, by Rao Bahadur Dr. A. Lakshmanaswami Mudaliar, M.D., F.C.O.G.

5. Government Orders were passed ordering the transfer of the degree class in the Maharani's College, Mysore, to Bangalore, with effect from 1939–40.

6. *Convocation.*—The 21st Annual Convocation of the University will be held at Mysore on Thursday, the 6th October 1938. Rev. C. F. Andrews has been invited to deliver the Convocation Address.

7. *Recognition of Examination.*—The B.T. Degree examination of this University is recognised by the University of Bombay as equivalent to its B.T. degree examination for purposes of admission into M.Ed. examination.

* * *

Lucknow University.—The following candidates are declared eligible to receive the Degree of D.Sc.:—(1) Mr. Shyam Sundar Lal Pradhan, M.Sc. The topic of his Thesis was "Morphological Studies on some Indian Coccinellids". (2) Mr. Daya Shankar Surbahi, M.Sc. The topic of his Thesis was "The Anatomy of Indian Carp, *Labeo rohita*".

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Mr. K. N. Kaul, Research Assistant to Prof. B. Sahni, appointed Demonstrator of Botany at the University of Lucknow. Mr. R. V. Sitholey, research student, selected as Research Assistant in place of Mr. K. N. Kaul. Mr. Bahadur Singh, research student in the same department, appointed Lecturer in Botany at the Balvant Rajput College, Agra. Mr. T. N. Srivastava, research student in Botany at Lucknow, appointed an Indian Forest Service probationer at Dehra Dun. Mr. N. P. Choudhury, another research student in the Department, appointed Demonstrator in Botany at the Agricultural College, Mandalay. Dr. S. C. Varma, Ph.D. (London), Demonstrator in Botany at Lucknow University, appointed Lecturer in Botany at the Agricultural College, Mandalay.

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We have pleasure in announcing that **Hon'ble Sir S. M. Sulaiman, Kt., M.A., LL.D., D.Sc., F.N.I.**, Delhi; **Mr. E. F. G. Gilmore, B.Sc. (Hons.), M.I.M.E.**, Director, Industrial Research Bureau, Calcutta; **Dr. S. Siddiqui, D.Phil. Nat.**, Director, Research Institute, A. & U. Tibbi College, Delhi; and **Khan Bahadur Dr. M. Afzal Husain, M.A., M.Sc., I.A.S.**, have accepted our invitation to join the Board of Editorial Co-operation.

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Announcements.

Federation of University Women in India.—The following Fellowships are available to members of the above Federation 1939-40:—

1. International Senior Fellowship in Arts (£ 250).
2. International (A.A.U.W. Fellowship Crusade) Fellowship ($ 1500).
3. International Residential Fellowship at Crosby Hall (£ 100).

4. Helsinki Hospitality Fellowship.
5. Bursaries at Crosby Hall.
6. Research Fellowship, University of Sydney, Australia (1939–41) £200 per annum.

Further information regarding the above can be had from the Hon. Gen. Secretary, Federation of University Women in India, 31, Adder Road, Cumballa Hill, Bombay.

International Technical Commission of Pharmacopœial Experts.—At the recent session of the Health Organization of the League of Nations, a Commission was appointed to carry on the work of the Brussels Conference for the establishment of standards for potent medicines. The Committee consists of C. H. Hampshire, Chairman (London), H. Baggesgarad (Copenhagen,) V. E. Zunz (Brussels), M. Tiffeneau (Paris), R. Eder (Zurich), L. Van Itallie (Leyden), E. Fullerton Cook (Philadelphia), and a member of the Union of Soviet Socialist Republics.

The Brussels Conference was the outgrowth of earlier efforts to establish an International Pharmacopœia. In 1902 a group of pharmacists from Brussels, in the name of the Belgian Government, issued invitations to practically all nations of the world to participate in a Conference for the purpose of establishing uniformity in the definition and strength of the more potent medicines in use throughout the world.

A second Conference was called for 1914, but was postponed because of the World War. The second Conference was finally assembled at Brussels in 1925, with representatives from more than 40 nations participating. Additional uniformity in standards and preparations was recommended and the Conference adjourned after passing recommendations that its work be taken over by the Health Organization of the League of Nations.

The establishment of a Pharmacopœial Secretaryship at the League, has been the basis for discussion for many years but the actual establishment of the programme has only now been completed. The Chairman of the Committee is the Secretary of the British Pharmacopœial Commission, which has recently published the First Supplement to the *British Pharmacopœia*.

The International Commission plans to compile a list of the more important medicines used throughout the world and invite the National Pharmacopœial Commissions in various countries to prepare model monographs, which, when finally approved, will be presented to the Pharmacopœial Commissions of the world with the hope that they may assist in bringing about greater uniformity in titles, definitions, descriptions, tests for identity and purity, and methods of assay.

It is hoped also that it will compile the pharmacopœial literature of the world for the use of all pharmacopœial commissions (*Ind. and Eng. Chem.*, News Edition, 1938, **16**, 376).

The attention of our readers is drawn to a review on **"Reports on Progress in Physics"** appearing elsewhere in this number. The volume is a comprehensive review, by leading physicists, of recent work in general and atomic physics, and can be purchased from the Manager, Physical Society, 1. Lowther Gardens, Exhibition Road, London S.W. 7 (Price 20*sh.* post free).

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We acknowledge with thanks, receipt of the following :—

"Agricultural College Magazine, Nagpur," Vol. 13. No. 4.
"Agricultural Gazette of New South Wales," Vol. 39, No. 8.
"Journal of Agricultural Research," Vol. 57, No. 1.
"Monthly Bulletin of Agricultural Science and Practice," Vol. 29, No. 7.
"Agricultural and Live-stock in India," Vol. 8, Part 4.
"The Philippine Agriculturist," Vol. 26, No. 3.
"Journal of the Royal Society of Arts," Vol. 86, Nos. 4470–74.
"Biochemical Journal," Vol. 32, No. 7.
"Journal of the Institute of Brewing," Vol. 43, No. 12 and Vol. 44, No. 1.
"Chemical Age," Vol. 39, Nos. 995–99.
"Journal of Chemical Physics," Vol. 6, No. 8.
"Journal of the Indian Chemical Society," Vol. 15, No. 6.
"Berichte der Deutschen Chemischen Gesselschaft," Vol. 71, No. 8.
"Journal de chemie physique," Vol. 35, No. 6.
"Russian Journal of General Chemistry," Vol. 8, Nos. 5 and 6.
"Experiment Station Record," Vol. 79, Nos. 1–2 and Index to Vol. 77.
"Indian Forester," Vol. 64, No. 9.
"Transactions of the Faraday Society," Vol. 34, No. 208.
"Forschungen und Fortschritte," Vol. 14, Nos. 22–24.
"Bulletin of the Health Organization, League of Nations," Vol. 7, No. 3.
"Medico-Surgical Suggestions," Vol. 7, No. 8.
"Calcutta Medical Journal," Vol. 34, No. 3.
"Mathematics Student," Vol. 5, No. 4.
"Review of Applied Mycology," Vol. 37, Nos. 4–7 and Index to Vol. 36.
"Nature," Vol. 142, Nos. 3587–90 and Index to Vol. 141.
"Journal of Nutrition," Vol. 16, Nos. 1–2.
"Proceedings of the Royal Society of Edinburgh," Vol. 57, Parts 1–4 and Vol. 58, Part 1.
"Research and Progress," Vol. 4, No. 5.
"Canadian Journal of Research," Vol. 16, Nos. 6 and 7.
"Sky," Vol. 2, No. 10.
"The Indian Trade Journal," Vol. 130, Nos. 1677–81.

Catalogues.

Wheldon and Wesleys, Ltd., London. (1) "Books on Microscopy," (2) "Natural History and Science".

The Forest Research Institute, Dehra Dun—"Classified Catalogue," 1934.

ACADEMIES AND SOCIETIES.

National Academy of Sciences, India:

April 1938.—M. A. H. SIDDIQI: *The Genito-urinary System of the Indian Ground Squirrel* (Funambulus palmarum).—The gross anatomy of the male genito-urinary system has been described. A microscopic study of the entire lower portion of the system has also been made. J. DAYAL: *On a New Species of the Genus* Astiotrema *Looss.*, 1901, *from the Intestine of a Fresh-water Fish,* Clarias batrachus (*from Lucknow*).—*Astriotrema dassia*, a small trematode, 2·2 mm. long by 0·42 mm. broad is described. A key to the species of the genus is given. M. ABDUSSALAM: *On the Occurrence of Skrjabinema ovis* (Skrjabin, 1918) in India.—*Skrjabinema ovis* has been recorded as occurring in a fat-tailed sheep, born and reared at the Allhabad Grantee Farm, Jahania (Punjab), for the first time in India. U. N. CHATTERJI: *Studies on the Effect of Alcohol on the Respiratory Rate of Leaves.*—The accelera-tion of respiratory rate produced by alcohol decreases with time.

Indian Academy of Sciences:

August 1938. SECTION A.—B. F. FERREIRA AND T. S. WHEELER: *A Study of the Benzoin Reaction—VI. The Effect of Temperature Variation on the Benzoin Reaction.*—In the absence of solvents and diluents, the homogeneous auto-catalytic reaction remains unaltered between 80° and 110° C. while the slow heterogenous reaction has its rate approximately doubled for each 10° C. rise in temperature. T. M. K. NEDUNGADI: *Diffraction of X-rays in Organic Glasses.*—Pictures have been taken with glycerine, salol and benzophenone, both in the liquid and the glassy state and compared. BISHAMBHAR DAYAL SAKSENA: *Raman Spectra of Some Organic Bi-cyclic Compounds. Naphthalene, Decaline, Tetralin, Indene,* Trans-β-*Decoline and* Trans-β-*Decalol.*—Polarisation measurements have also been made except for *trans*-β-Decalol, and the characteristics agree with the group theory results. The *cis*- and *trans*-lines of decaline have been separated. S. BHAGAVANTAM AND T. VENKATARAYUDU: *The Normal Modes and Frequencies of the Sulphur Molecule.*—These have been worked out on the assumption that the eight atoms in the molecule occupy the corners of a puckered octagon, and the conclusions are in agreement with the observations. Detailed expressions are also derived for the normal frequencies by postulating three types of forces, namely, primary valence, directed valence and repulsive forces. S. BHAGAVANTAM AND T. VENKATARAYUDU: *Raman Spectrum and Specific Heat of Sulphur.*—The specific heat of sulphur is represented as the sum of a Debye function and a number of Einstein functions associated with the various normal frequencies. The calculated values compare favourably with the observations. S. BHAGAVANTAM AND T. VENKATARAYUDU: *The Normal Frequencies of Phosphorus* (P_4).—By the application of group theoretical methods, the frequencies and specific heat of phosphorus have been calculated and shown to be in agreement with observations. K. NAGABHUSHANA RAO: *Diffraction of Light by Ultrasonic Waves.*—The results of Raman and Nath's general theory are shown to be in complete agreement with Van Cittert's theory. The amplitude function for oblique incidence is developed *in extenso* in a series of Bessel functions. K. S. K. IYENGAR: *On Linear Transformations of Bounded Sequences—III.*

August 1938. SECTION B.—H. CHAUDHURI AND MOHD. UMAR: *Molds of the Punjab—I. The Aspergilli.* H. CHAUDHURI: *Molds of the Punjab—II. The Penicillia.* G. N. RANGASWAMI AYYANGAR AND M. A. SANKARA AYYAR: *Linkage betweeen a Panicle Factor and the Pearly-chalky Mesocarp Factor (Zz) in Sorghum.*—A factor Pa_1 produces loose conical earheads: factor pa_1 results in compact spindle-shaped earheads. These factors Pa_1 pa_1 affecting the panicle shape are closely linked to the factors Zz governing the thickness of mesocarp and the deposit of starch in it, with a cross-over value of 1·07 per cent.

Indian Chemical Society:

May 1938.—B. N. GHOSH AND S. S. DE: *The Effect of Hydrogen-ion Concentration, Electrolytes and of Normal and Immune Sera on the Cataphoretic Velocity of* Leishamania tropica—*Part I.* S. N. RAY: *Effect of Hyperthyridism on the Metabolism of Vitamin C.* TEJENDRA NATH GHOSH: *Quinoline Derivatives—Part V.* S. C. GANGULI AND DAS-GUPTA: *Studies in Indian Bauxite—Part I. Chromium and Vanadium.* K. M. CHAKRAVARTY: *Catalytic Formation of Methane from Monoxide and Hydrogen—Part V. A Study of the Promoter Effect upon Nickel Catalyst.* K. V. GIRI: *Further Studies on the Hydrolysis of Starch by Sweet Potato Amylase.* SUNIL BIHARI SEN-GUPTA: *Studies in the Fluorescence of Dyestuffs.*

June 1938.—SHIVANANDAN PRASAD, AMRITANSU SEKHAR CHAKRAVARTI AND BALBHADRA PRASAD: *Viscosity and Density of Aqueous Solutions of Mercuric Chloride at 35°.* BASANTA KUMAR GHOSH: *Compounds of Hexamethylenetetramine with Simple and Double Salts of Cobalticyanic Acid and the Nature of Residual Affinity.* PRAFULLA KUMAR BOSE AND SACHINDRA NATH BHATTACHARYA: *Natural Flavones—Part II. On the Colouring Matters of the Bark of* Oroxylum indicum, *Vent.* PRODOSHCHANDRA RAYCHAUDHURY: *Estimation of Chromium by Alkaline Mercuric Oxide.* ATMA RAM AND N. R. DHAR: *Formaldehyde Formation in the Photo-oxidation of Organic Substances and the Formaldehyde Theory of Carbon Assimilation.*

The Dacca Botanical Society:

August 1, 1938.—N. K. CHATTERJI: *Some Aspects of Respiration and Respiratory Quotient of Plants.* S. HEDAYETULLAH AND S. P. RAY CHOUDHURY: *A Note on the Study of* Sclerotium oryzæ. P. N. MAZUMDAR: *Utility of a Planned Garden attached to Schools in Bengal.*

SUPPLEMENT TO "CURRENT SCIENCE".

Vol. VII] September 1938 [No. 3

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Cambridge, 1938.

THE PRESIDENTIAL ADDRESS.

Part I.

VISION IN NATURE AND VISION AIDED BY SCIENCE.

Part II.

SCIENCE AND WARFARE.

By The Rt. Hon. Lord Rayleigh, Sc.D., LL.D., F.R.S.,
President of the Association.

I.

Vision, and its Artificial Aids and Substitutes.

THE last occasion that the British Association met at Cambridge was in 1904, under the presidency of my revered relative, Lord Balfour, who at the time actually held the position of Prime Minister. That a Prime Minister should find it possible to undertake this additional burthen brings home to us how much the pace has quickened in national activities, and I may add, anxieties, between that time and this.

Lord Balfour in his introductory remarks recalled the large share which Cambridge had had in the development of physics from the time of Newton down to that of J. J. Thomson and the scientific school centred in the Cavendish Laboratory, 'whose physical speculations,' he said, 'bid fair to render the closing year of the old century and the opening ones of the new as notable as the greatest which have preceded them.' It is a great pleasure to me, as I am sure it is to all of you, that my old master is with us here to-night, as he was on that occasion. I can say in his presence that the lapse of time has not failed to justify Lord Balfour's words. What was then an intelligent anticipation is now an historical fact.

I wish I could proceed on an equally cheerful note. The reputation of the scientific school in the Cavendish Laboratory has been more than sustained in the interval under the leadership of one whose friendly presence we all miss to-night. The death of Ernest Rutherford leaves a blank which we can never hope to see entirely filled in our day. We know that the whole scientific world joins with us in mourning his loss.

Lord Balfour's address was devoted to topics which had long been of profound interest to him. He was one of the first to compare the world picture drawn by science and the world picture drawn by the crude application of the senses, and he emphasised the contrast between them. A quotation from his address will serve as an appropriate text to introduce the point of view which I wish to develop this evening.

'So far,' he said, 'as natural science can tell us, every quality or sense or intellect which does not help us to fight, to eat, and to bring up our children, is but a by-product of the qualities which do. Our organs of sense perception were not given us for purposes of research....either because too direct a vision of physical reality was a hindrance, not a help in the struggle for existence....or because with so imperfect a material as living tissue no better result could be attained.'

Some of those who learn the results of modern science from a standpoint of general or philosophical interest come away, I believe, with the impression that what the senses tell us about the external world is shown to be

altogether misleading. They learn, for example, that the apparent or space-filling quality of the objects called solid or liquid is a delusion, and that the volume of space occupied is held to be very small compared with that which remains vacant in between. This is in such violent contrast with what direct observation seems to show that they believe they are asked to give up the general position that what we learn from our senses must be our main guide in studying the nature of things.

Now this is in complete contrast with the standpoint of the experimental philosopher. He knows very well that in his work he does and must trust in the last resort almost entirely to what can be seen, and that his knowledge of the external world is based upon it: and I do not think that even the metaphysician claims that we can learn much in any other way. It is true that the conclusions of modern science seem at first sight to be very far removed from what our senses tell us. But on the whole the tendency of progress is to bring the more remote conclusions within the province of direct observation, even when at first sight they appeared to be hopelessly beyond it.

For example, at the time of Lord Balfour's address some who were regarded as leaders of scientific thought still urged that the conception of atoms was not to be taken literally. We now count the atoms by direct methods. We see the electrometer needle give a kick and we say, 'There goes an atom.' Or we see the path of an individual atom marked out by a cloud track and we see where it was abruptly bent by a violent collision with another atom.

Again, the theory of radioactive decomposition put forward by Rutherford, however cogent it may have seemed and did seem to those who were well acquainted with the evidence, was originally based on indirect inferences about quantities of matter far too small to be weighed on the most delicate balance. Chemists were naturally inclined to feel some reserve; but in due course the theory led to a conclusion which could be tested by methods in which they had confidence—the conclusion, namely, that lead contained in old uranium minerals ought to have a lower atomic weight than ordinary lead and in all probability to be lighter, and on trying this out it proved to be so. More recently we have the discovery of heavy hydrogen with twice the density of ordinary hydrogen and heavy water which is the source of it.

Lastly, the conclusion that ordinary matter is not really space-filling has been illustrated by the discovery that certain stars have a density which is a fabulous multiple of the density of terrestrial matter. Although this is in some sense a deduction as distinguished from an observation, yet the steps required in the deduction are elementary ones entirely within the domain of the older physics.

This and many other points of view have seemed at first sight to contradict the direct indication of our senses. But it was not really so. They were obtained and could only be obtained by sense indications rightly interpreted. As in the passage from Lord Balfour already quoted the senses were not primarily developed for purposes of research, and we have in large measure to adapt them to that purpose by the use of artificial auxiliaries. The result of doing so is often to reveal a world which to the unaided senses seems paradoxical.

I have chosen for the main subject of this address a survey of some of the ways in which such adaptations have been made. I shall naturally try to interest you by dwelling most on aspects of the subject that have some novelty; but apart from these there is much to be gleaned of historical interest, and when tempted I shall not hesitate to digress a little from methods and say something about results.

I shall begin with a glance at the mechanism of the human eye, so far as it is understood. I shall show how the compromise and balance between different competing considerations which is seen in its design can be artificially modified for special purposes. All engineering designs are a matter of compromise. You cannot have everything. The unassisted eye has a field of view extending nearly over a hemisphere. It gives an indication very quickly and allows comparatively rapid changes to be followed. It responds best to the wave-lengths actually most abundant in daylight or moonlight. This combination of qualities is ideal for what we believe to be nature's primary purpose, that is, for finding subsistence under primitive conditions and for fighting the battle of life against natural enemies. But by sacrificing some of these qualities, and in particular the large field of view, we can enhance others for purposes of research. We

may modify the lens system by artificial additions over a wide range for examining the very distant or the very small. We can supplement and enormously enhance the power of colour discrimination which nature has given us. By abandoning the use of the retina and substituting the photographic plate as an artificial retina, we can increase very largely the range of spectrum which can be utilised. This last extension has its special possibilities, particularly in the direction of using waves smaller than ordinary, even down to those which are associated with a moving electron. By using the photoelectric cell as another substitute for the retina with electric wire instead of optic nerve and a recording galvanometer instead of the brain we can make the impressions metrical and can record them on paper. We can count photons and other particulate forms of energy as well. We can explore the structure of atoms, examine the disintegration of radioactive bodies, and trace out the mutual relation of the elements. Indeed, by elaborating this train of thought a little further almost the whole range of observational science could be covered. But within the compass of an hour or so one must not be too ambitious. It is not my purpose to stray very far from what might, by a slight stretch of language, fall under the heading of extending the powers of the eye.

Most people who have a smattering of science now know the comparison of the eye with the camera obscura, or better, with the modern photographic camera—with its lens, iris, diaphragm, focussing adjustment and ground glass screen, the latter corresponding to the retina. The comparison does not go very far, for it does not enter upon how the message is conveyed to the brain and apprehended by the mind; or even upon the minor mystery of how colours are discriminated. Nevertheless, it would be a great mistake to suppose that the knowledge which is embodied in this comparison was easily arrived at. For example, many acute minds in antiquity thought that light originated in the eye rather than in the object viewed. Euclid in his optics perhaps used this as a mathematical fiction practically equivalent to the modern one of reversing the course of a ray, but other authors appealed to the apparent glow of animal eyes by lamplight, which shows that they took the theory quite literally. The Arabian author Alhazen had more correct ideas and he gave an anatomical description of the eye, but apparently regarded what we call the crystalline lens as the light-sensitive organ. Kepler was the first to take the modern view of the eye.

The detailed structure of the retina, and its connection with the optic nerve, has required the highest skill of histologists in interpreting difficult and uncertain indications. The light-sensitive elements are of two kinds, the rods and cones. The rods seem to be the only ones used in night vision, and do not distinguish colours. The cones are most important in the centre of the field of view, where vision is most acute, and it seems to be fairly certain that in the foveal region each cone has its own individual nervous communication with the brain. On the other hand, there is not anything like room in the cross-section of the optic nerve to allow us to assign a different nerve fibre to each of the millions of rods. A single fibre probably has to serve 200 of them.

The nervous impulse is believed to travel in the optic nerve as in any other nerve, but what happens to it when it arrives at the brain is a question for the investigators of a future generation.

The use of lenses is one of the greatest scientific discoveries: we do not know who made it. Indeed, the more closely we inquire into this question the vaguer it becomes. Spectacle lenses as we know them are a mediæval invention, dating from about A.D. 1280. Whether they originated from some isolated thinker and experimentalist of the type of Roger Bacon, or whether they were developed by the ingenuity of urban carftsmen, can hardly be considered certain. There are several ways in which the suggestion might have arisen, but a glass bulb filled with water is the most likely. Indeed, considering that such bulbs were undoubtedly used as burning glasses in the ancient world, and that the use of them for reading small and difficult lettering is explicitly mentioned by Seneca, it seems rather strange that the next step was not taken in antiquity. Apparently the explanation is that the magnification was attributed to the nature of the water rather than to its shape. At all events, it may readily be verified that a 4- or 5-inch glass flask full of water, though not very convenient to handle, will give a long-sighted newspaper reader the same help that he could get from a monocle.

The invention of lenses was a necessary preliminary to the invention of the telescope, for, as Huygens remarked, it would require a superhuman genius to make the invention theoretically.

The retina of the eye on which the image is to be received has structure. We may compare the picture on the retina to a design embroidered in wool-werk, which also has a structure. Clearly such a design cannot embody details which are smaller than the mesh of the canvas which is to carry the coloured stitches. The only way to get in more details is to make the design, or rather such diminished part of it as the canvas can accommodate, on a larger scale. Similarly with the picture on the retina. The individual rods and cones correspond with the individual meshes of the canvas. If we want more detail of an object we must make the picture on the retina larger, with the necessary sacrifice of the field of view. If the object is distant, we want for this a lens of longer focus instead of the eye lens. We cannot take the eye lens away, but, what amounts to nearly the same thing, we can neutralise it by a concave lens of equal power put right up to it, called the eye-piece. Then we are free to use a long focus lens called the telescopic objective to make a larger picture on the retina. It must of course be put at the proper distance out to make a distinct picture. This is a special case of the Galilean telescope which lends itself to simple description. It is of no use to make the picture larger if we lose definition in the process. The enlarged image must remain sharp enough to take advantage of the fine structure of the retinal screen that is to receive it. It will not be sharp enough unless we make the lens of greater diameter than the eye. Another reason for using a large lens is to avoid a loss of brightness.

It seems paradoxical that the image of a star should be smaller the larger the telescope. Nevertheless it is a necessary result of the wave character of light. We cannot see the true nature of, for example, a double star, unless the two images are small enough not to overlap and far enough apart to fall on separated elements of the observer's retina.

When the problem is to examine small objects we look at them as close as we can: here the short-sighted observer has an advantage. By adding a lens in front of the eye lens to increase its power we can produce a kind of artificial short sight and get closer than we could otherwise, so that the picture on the retina is bigger. This is a simple microscope and we can use it to examine the image produced by an objective lens; if this image is larger than the object under examination we call the whole arrangement a compound microscope.

Given perfect construction there is no limit in theory to what a telescope can do in revealing distant worlds. It is only a question of making it large enough. On the other hand, there is a very definite limit to what the microscope used with, say, ordinary daylight can do. It is not that there is any difficulty in making it magnify as much as we like. This can be done, *e.g.*, by making the tube of the microscope longer. The trouble is that beyond a certain point magnification does no good. Many people find this a hard saying, but it must be remembered that a large image is not necessarily a good image. We are up against the same difficulty as before. A point on the object is necessarily spread out into a disc in the image, due to the courseness of structure of light itself as indicated by its wave-length. I cannot go into the details, but many of you will know that points on the object which are something less than half a wave-length or say a one hundred-thousandth of an inch apart, cannot be distinctly separated. This is the theoretical limit for a microscope using ordinary light, and it has been practically reached. The early microscopists would have thought this more than satisfactory; but the limit puts a serious obstacle in the way of biological and medical progress today. For example, the pathogenic bacteria in many cases are about this size or less; and there is special interest in considering in what directions we may hope to go further.

Since microscopic resolution depends on having a fine structure in the light itself, something though not perhaps very much, may be gained by the use of ultra-violet light instead of visible light. It then becomes necessary to work by photography. We are nearing the region of the spectrum where almost everything is opaque. In the visual region nearly every organic structure is transparent and to get contrast stains have to be used which colour one part more deeply than the other. In the ultra-violet, on the other hand, we get contrast without staining and, as Mr. J. W. Barnard has shown, the

advantage lies as much in this as in the increased resolving power. For example, using the strong ultra-violet line of the mercury vapour lamp, which has about half the wave length of green light, he finds that a virus contained within a cell shows up as a highly absorptive body in contrast with the less absorptive element of the cell. So that ultra violet microscopy offers some hope of progress in connection with this fundamental problem of the nature of viruses.

With ultra violet microscopy we have gone as far as we can in using short waves with ordinary lenses made of matter, for the available kinds of matter are useless for shorter waves than these, and it might well seem that we have here come to a definite and final end. Yet it is not so. There are two alternatives, which we must consider separately. Paradoxical as it may seem, for certain radiations we can make converging lenses out of empty space; or alternatively we can make optical observations without any lenses at all.

The longstanding controversy which raged in the nineties of the last century as to whether cathode rays consisted of waves or of electrified particles was thought to have been settled in favour of the latter alternative. But scientific controversies, however acutely they may rage for a time, are apt, like industrial disputes, to end in compromise; and it has been so in this instance. According to our present views the cathode rays in one aspect consist of a stream of electrified particles; in another, they consist of wave trains, the length being variable in inverse relation to the momentum of the particles.

Now cathode rays have the property of being bent by electric or magnetic forces, and far reaching analogies have been traced between this bending and the refraction of light by solids; indeed, a system of 'electron optics' has been elaborated which shows how a beam of cathode rays issuing from a point can be reassembled into an image by passing through a localised electrostatic or magnetic field having axial symmetry. This constitutes what has been called an electrostatic or magnetic lens. It is then possible to form a magnified image of the source of electrons on a fluorescent screen, and that is the simplest application. But we can go further and form an image of an obstructing object such as a fine wire by means of one magnetic lens, acting as objective, and amplify it by means of a second magnetic lens, which is spoken of as the eye-piece, though of course it is only such by analogy, for the eye cannot deal directly with cathode rays. The eye-piece projects the image on to a fluorescent screen, or photographic plate. So far we have been thinking of the electron stream in its corpuscular aspect. But we must turn to the wave aspect when it comes to consideration of theoretical resolving power. The wave-length associated with an electron stream of moderate velocity is so small that if the electron microscope could be brought to the perfection of the optical microscope, it should be able to resolve the actual atomic structure of crystals. This is very far indeed from being attained, the present electron microscope being much further from its own ideal than were the earliest optical microscopes. Nevertheless experimental instruments have been constructed which have a resolving power several times better than the modern optical microscope. The difficulty is to apply them to practical biological problems.

It is not to be supposed that the histological technique so skilfully elaborated for ordinary microscopy can at once be transferred to the electron microscope. For example, the relatively thick glass supports and covers ordinarily used are out of the question. Staining with aniline dyes is probably of little use, and the fierce bombardment to which the delicate specimen is necessarily exposed will be no small obstacle. Certain standard methods, however, such as impregnation with osmium, seem to be applicable: and there is some possibility that eventually the obscure region between the smallest organisms and the largest crystalline structure may be explored by electron microscopy.

In referring to the limitations on the use of lenses I mentioned the other alternative that we might, in order to work with the shortest waves, dispense with lenses altogether: and in fact in using X-rays this is done. We are then limited to controlling the course of the rays by means of tubes or pinholes. This restriction is so serious that it altogether defeats the possibility of constructing a useful X-ray microscope analogous to the optical or the electron microscope. In spite of this the use of X-rays is of fundamental value for dealing with a particular class of objects, namely, crystals which themselves have a regular spacing, comparable in size with the length of the waves. Just as the spacing of

a ruled grating (say one 1/20,000th of an inch) can be compared with the wave-length of light by measuring the angle of diffraction, so the spacing of atoms in a crystal can be compared with the wave-length of X-rays. But here the indications are less direct than with the microscope, and depend on the object having a periodic structure. So that the method hardly falls within the scope of this address. How essential the difference is will appear if we consider that the angle to be observed becomes greater and not less the closer the spacing of the object under test.

Colour vision is one of nature's most wonderful achievements, though custom often prevents our perceiving the wonder of it. We take it for granted that anyone should readily distinguish the berries on a holly bush, and we are inclined to be derisive of a colour-blind person who cannot do so. But so far anatomy has told us little or nothing of how the marvel is achieved. Experiments on colour vision show that three separate and fundamental colour sensations exist. It is probable that the cones of the retina are responsible for colour vision and the rods for dark adapted vision which does not discriminate colour. But no division of the cones into three separate kinds corresponding to the three colour sensations has ever been observed. Nor is any anatomical peculiarity known which allows a colour-blind eye to be distinguished from a normal one.

Can artificial resources help to improve colour discrimination? In some interesting cases they can. Indeed, the whole subject of spectroscopy may be thought of as coming under this head. We can recognise the colour imparted by sodium to a flame without artificial help. When potassium is present as well, the red colour due to it can only be seen when we use a prism to separate the red image of the flame from the yellow one. Such a method has its limitations, because if the coloured images are more numerous they overlap, and the desired separation is lost. To avoid this it is necessary to make a sacrifice, and to limit the effective breadth of the flame by a more or less narrow slit. And if the images are very numerous the slit has to be so narrow that all indication of the breadth of the source is lost. This, of course, is substantially the method of spectroscopy, into which I do not enter further. But there is an interesting class of cases where we cannot afford to sacrifice the form of the object entirely to colour discrimination. Consider, for example, the prominences of the sun's limb, which are so well seen against the darkened sky of an eclipse, but are altogether lost in the glare of the sky at other times. In order to see them prismatic dispersion is made use of, and separates the monochromatic red light of hydrogen from the sky background. A slit must be used to cut off the latter: but if it is too narrow the outlines of the prominence cannot be seen. By using a compromise width it is possible to reconcile the competing requirements in this comparatively easy case. Indeed, M. B. Lyot, working in the clear air of the observatory of the Pic du Midi, where there is less false light to deal with, has even been able to observe the prominences through a suitable red filter, which enables the whole circumference of the sun to be examined at once, without the limitations introduced by a slit. A much more difficult problem is to look for bright hydrogen eruptions projected on the sun's disc, and at first sight this might well seem hopeless. A complete view of them was first obtained by photography, but I shall limit myself to some notice of the visual instrument perfected by Hale and called by him the spectrohelioscope. A very narrow slit has to be used, and hence only a very small breadth of the sun's surface can be seen at any one instant. But the difficulty is turned by very rapidly exposing to view successive strips of the sun's surface side by side. The images then blend, owing to persistence of vision, and a reasonably broad region is included in what is practically a single view. I must pass over the details of mechanism by which this is carried out.

There are now a number of spectrohelioscopes over different parts of the world, and a continuous watch is kept for bright eruptions of the red hydrogen lines. Already these are found to be simultaneous with the 'fading' of short radio waves over the illuminated hemisphere of the earth, and the brightest eruptions are simultaneous with disturbances of terrestrial magnetism. At the Mount Wilson Observatory such eruptions have been seen at the same time at widely separated points on the sun, indicating a deep-seated cause. There are therefore very interesting and fundamental questions within the realm of this method of investigation.

We have so far been mainly considering how

we may adapt our vision for objects too small or too far off for unassisted sight, and for colour differences not ordinarily perceptible. This is chiefly done by supplementing the lens system of the eye by additional lenses or by prisms. We cannot supplement the retina, but in certain cases we can do better. We can substitute an artificial sensitive surface which may be either photographic or photoelectric.

That certain pigments are bleached by light is an observation that must have obtruded itself from very early times—indeed, it is one of the chief practical problems of dyeing to select pigments which do not fade rapidly. If a part of the coloured surface is protected by an opaque object—say a picture or a mirror hanging over a coloured wallpaper—we get a silhouette of the protecting object, which is in essence a photograph.

Again, it is a matter of common observation that the human skin is darkened by the prolonged action of the sun's light, and here similarly we may get what is really a silhouette photograph of a locket, or the like, which protects the skin locally. In this case we are perhaps retracing the paths which Nature herself has taken: for the evolution of the eye is regarded as having begun with the general sensitiveness to light of the whole surface of the organism.

The sensitivity of at all events the dark adapted eye depends on the accumulation on the retinal rods of the pigment called the visual purple of which the most striking characteristic is its ready bleaching by light. We can even partially 'fix' the picture produced in this way on the retina of, for example a frog by means of alum solution. This brings home to us how clearly akin are the processes in the retina to those in the photographic plate, even though the complexity of the former has hitherto largely baffled investigation.

There are then many indications in nature of substances sensitive to light, and quite a considerable variety of them have from time to time been used in practical photographic processes. But compounds of silver, which formed the basis of the earliest processes, have maintained the lead over all others. The history of photography by means of silver salts cannot be considered a good example of the triumph of the rational over the empirical. For instance, the discovery of developers came about thus. The first workers, Wedgewood and Davy (1802), had found that they got greater sensitivity by spreading the silver salt on white leather instead of paper. An early experimenter, the Rev. J. B. Reade (1837), was anxious to repeat this experiment, and sacrificed a pair of white kid gloves belonging to his wife for the purpose. When he wished to sacrifice a second pair, the lady raised a not unnatural objection, and he said, 'Then I will tan paper.' He treated paper with an infusion of oak galls and found that this increased the sensitivity greatly. It amounted to what we should call exposing and developing simultaneously. But, in using the method, it is easily observed that darkening continues after exposure is over, and this leads to beginning development after the exposure. This step was taken by Fox Talbot a year or two afterwards. Instead of crude infusion of galls he used gallic acid. Later pyrogallic acid was used instead of gallic acid, and still survives.

The use of gelatine as a medium to contain the silver halide was a more obvious idea. But it was not so easy to foresee that the sensitivity of silver salts would be much further increased when they were held in this medium. For long this remained unexplained, until it was noticed that some specimens of gelatine were much more active than others. This was ultimately traced by S. E. Sheppard to the presence of traces of mustard oil, a sulphur compound, in the more active specimens. This, in turn, depends in all probability on the pasturage on which the animals that afford the gelatine have been fed. The quantity present is incredibly small, comparable in quantity with the radium in pitchblende.

The value to science as well as to daily life of the gelatine dry plate or film can hardly be over-estimated. Take, for instance, the generalised principle of relativity, which attempts with considerable success to reduce the main feature of the cosmical process to a geometrical theory. The crucial test requires us to investigate the gravitational bending of light, by photographing the field of stars near the eclipsed sun. For this purpose the gelatine dry plate has been essential: and here, as we have seen, we get into complicated questions of bio-chemistry. This is to my mind a beautiful example of the interdependence of different branches of science and of the disadvantages of undue specialisation (or should I say generalisa-

tion ?). We may attempt to reduce the cosmos to the dry bones of a geometrical theory, but in testing the theory we are compelled to have recourse again to the gelatine which we have discarded from the dry bones !

To come back, however, to the development of the photographic retina, as I may call it. As is well known, the eye has maximum sensitivity to the yellow-green of the spectrum, but ordinary silver salts are not sensitive in this region. Their maximum is in the blue or violet, and ranges on through ultra-violet to the X-ray region. It was not at all easy to extend it on the other side through green, yellow and red to infra-red. The story of how this was ultimately attained is one more example in the chapter of accidental clues skilfully followed up which forms the history of this subject.

In 1873, Dr. Hermann Vogel, of Berlin, noticed that certain collodion plates of English manufacture, which he was using for spectrum photography, recorded the green of the spectrum to which the simple silver salts are practically insensitive. The plates had been coated with a mixture which contained nitrate of uranium, gum, gallic acid and a yellow colouring matter. What the purpose of this coating was is not very obvious. It rather reminds one of mediæval medical prescriptions which made up in complexity what they lacked in clear thinking. But Vogel concluded with true scientific insight that it must owe the special property he had discovered to some constituent which absorbs the green of the spectrum more than the blue : for conservation of energy required that the green should be absorbed if it is to act on the plate. He then tried staining the plate with coralline red, which has an absorption band in the green, with the expected result. With much prescience he says : 'I think I am pretty well justified in inferring that we are in a position to *render bromide of silver sensitive for any colour we choose.* Perhaps we may even arrive at this, namely photographing the ultra-red as we have already photographed the ultra-violet.' It was, however, half a century before this far-seeing prophecy was fully realised. The development of the aniline colour industry gave full scope for experiment, but it has been found by bitter experience that dyes which can produce the colour sensitiveness are often fatal to the clean working and keeping qualities of the plate. However, success has been attained, largely by the efforts of Dr. W. H. Mills, of the Chemical Department of this University, and of Dr. Mees, of the Kodak Company ; and we all see the fruits of it in the photographs by lamplight which are often reproduced in the newspapers.

It is now known in what direction the molecular structure of the sensitising dye must be elaborated in order to push the action further and further into the infra-red, and the point when water becomes opaque has nearly been reached, with great extension of our knowledge of the solar spectrum. The spectra of the major planets have also been extended into the infra-red and this has given the clue as to the true origin of the mysterious absorption bands due to their atmospheres which had baffled spectroscopists for more than a generation. These bands have been shown by Wildt to be due to methane or marsh gas. Neptune, for example, has an atmosphere of methane equivalent to 25 miles thickness of the gas under standard conditions. In this Neptunian methane we have a paraffin certainly not of animal or vegetable origin ; and I venture in passing to make the suggestion that geologists might usefully take it into considertaion in discussing the origin of terrestrial petroleum.

The photographic plate is not the only useful substitute for the human retina. We have another in the photoelectric surface. The history of this discovery is of considerable interest. Heinrich Hertz, in his pioneering investigation of electric waves (1887), made use of the tiny spark which he obtained from his receiving circuit as an indicator. The younger part of my audience must remember that this was before the days of valves and loud speakers. His experiments were done within the walls of one room. When he boxed in the indicating spark so as to shield it from daylight and make it easier to see, he found that this precaution had exactly the opposite effect—the spark became less instead of more conspicuous. To express it shortly and colloquially, this action was found to depend on whether or not the spark of the receiver could see the spark of the oscillator. Moreover, seeing through a glass window would not do. It was ultraviolet light from the active spark that influenced the passive spark. Further, Hertz was able to determine that the action occurred

mainly, if not entirely, at the cathode of the passive spark.

The next step was taken by Hallwachs, who showed that it was not necessary to work with the complicated conditions of the spark. He found that a clean zinc plate negatively charged rapidly lost its charge when illuminated by ultra-violet light.

The final important step was in the use of a clean surface of alkali metal *in vacuo* which responds to visible light and passes comparatively large currents. This constitutes the photoelectric cell very much as we now have it, and was due to two German school-masters J. Elster and H. Geitel. English physicists who met them during their visit to Cambridge a generation ago will not fail to have agreeable memories of thier single-minded enthusiasm and devoted mutual regard. Sir J. J. Thomson has recalled them to our recollection in his recent book. They could scarcely have foreseen that their work, carried out in a purely academic spirit, would make possible the talking films which give pleasure to untold millions.

The sensitiveness of the dark-adapted eye has often been referred to as one of its most wonderful features; but under favourable conditions, the sensitivity of a photoelectric surface may even be superior. According to our present ideas, no device conceivable could do more than detect every quantum which fell upon it. Neither the eye nor the photoelectric surface comes very near to this standard, but it would seem that the falling short is rather in detail than in principle. The action of the photoelectric cell depends on the liberation of an electron by one quantum of incident energy, and under favourable conditions the liberation of one electron can be detected, by an application of the principle of Geiger's counter. The action of the dark-adapted eye depends on the bleaching of the visual purple. According to the results of Dartnell, Goodeve and Lythgoe it appears likely that one quantum can bleach a molecule of this substance, and in all probability this results in the excitation of a nerve fibre, which carries its message to the brain.

The photoelectric cell can be used like the photographic plate at the focus of an astronomical telescope. It might seem from the standpoint of evolution a retrograde step to substitute a single sensitive element for the 137 million such elements in the human eye. In this connection it is interesting to note that in certain invertebrate animals eyes are known which have the character of a single sensitive element, with a lens to concentrate the light upon it. Such an eye can do little more than distinguish light from darkness. But its artificial counterpart using the photoelectric surface has the valuable property that the electric current which indicates that light is falling upon it can be precisely measured, so as to determine the intensity of the light. In contrast with photographic action, the energy available to produce the record comes not from the original source of light, which only, as it were, pulls the trigger, but from the battery in the local circuit, and it may be amplified so as to actuate robust mechanisms. It has been applied with success to guiding a large telescope, or in a humbler sphere, to open doors, or even to catch thieves.

However, the scientific interest lies more in the possibility of accurate measurement. As an interesting example we might take the problem of measuring the apparent diameter of the great nebula in Andromeda. As is known, modern research tends to indicate that the Andromeda nebula and other like systems are the counterparts of the galaxy, being in fact island universes. But until lately there was a serious difficulty in that all such systems appeared to be considerably smaller than the galaxy. Stebbins and Whitford, by traversing a telescope armed with a photoelectric cell across the nebula, have found that its linear dimensions were twice as great as had been supposed, reducing the discrepancy of size to comparatively little.

But, it may be suggested, could we not go further and make a photoelectric equivalent, not only for the rudimentary kind of eye which has only a single sensitive element, but for the developed mammalian eye which has an enormous number? Could we not build up on separated photoelectric elements a complete and detailed picture? In point of fact this has been done in the development of television; and since this new art which interests us all can properly be considered as an extension of the powers of normal vision, no excuse is needed for devoting some consideration to it. We must divide the photoelectric surface into minute patches which are electrically insulated from one another. This is not too difficult; but if it were proposed directly to imitate nature, and attach a wire, representing a nerve fibre,

to each of these patches, so as to connect it to the auxiliary apparatus, we might well despair of the task; for there are probably half a million such connections between the human retina and the brain. In the artificial apparatus for television, one single connection is made to serve, but it is in effect attached to to each of the patches in rapid succession by the process of 'scanning' the image. The photoelectric mosaic is on one side of a thin mica sheet, and a continuous metal coating on the other side gives the connection, which is by electrostatic induction. Each element of the surface forms a separate tiny condenser with the opposing part of the back plate. Scanning is achieved by rapidly traversing a beam of electrons over the mosaic line by line. The whole surface, and therefore each element, must be scanned at least twenty times a second. In the intervals an element is losing electrons more or less rapidly. The scanning beam comes along, and restores the lost electrons, discharges the little condenser found by the element and the back plate and sends an electric signal into the wire attached to this plate. The strength of this signal will depend on how many electrons the element had lost since the previous scanning, and thus on the luminous intensity of that part of the image. An important point is that the element is in action all the time, and not only while it is individually being scanned. We have thus transmuted the momentary picture into a series of electric pulses occupying in all a time of one-twentieth of a second and these can be amplified and sent out as wireless signals. How are they to be turned back again into a visible picture at the other end? Well, that is not perhaps so difficult as the first conversion of the picture into signals. We must make a beam of electrons follow and imitate the periodic movements of the scanning beam at the other end. The beam of electrons falls on a luminescent screen, and makes it light up, more or less brightly according to the intensity of the electron beam. If we use the incoming signals to modulate the electron beam, we can make them correspond with the intensities at the sending end, and the original picture is reconstructed piece by piece. The reconstruction is completed in one-twentieth of a second or less, and the process begins again. The successive pictures blend into one another as in the cinema, and movement is shown with apparent continuity.

It seems not unlikely that the electric eye or iconoscope, as it has been called, may have applications apart from television. Dr. V. K. Zworykin, who took an important part in its development, suggested that it might be used to make visible the image in the ultra-violet microscope, which would be much too faint for direct projection on a fluorescent screen. For that purpose the sending and receiving apparatus would, of course, be connected directly, without radio transmission. It might also be used for rapid photography, if the photographic plate replaced the viewing screen. The beauty of the device is that the energy is supplied locally, the distant light source merely releasing it. The principle of amplification may thus perhaps be applied to the photographing of faint objects.

I come to the close of this part of my subject.

Much of modern scientific doctrine appears at first sight to have an elusive and even metaphysical character, and this aspect of it seems to make the strongest appeal to many cultivated minds. Yet upon the whole, the main triumphs of science lie in the tangible facts which it has revealed; and it is these which will without doubt endure as a permanent memorial to our epoch. My main thesis has been that these are discovered by methods not essentially different from direct scrutiny. It is hoped that the present survey may remind you that if we allow for a reasonable broadening of the original meaning of the words, it remains true after all that 'seeing is believing'.

II.

Science and Warfare.

During the Great War itself, few scientific men in any country doubted that it was their duty to do what they could do to apply their specialised knowledge to the purposes of war; nor was it often suggested by publicists that there was any countervailing consideration: on the contrary they urged strongly that our resources in this direction should be efficiently mobilised. It is chiefly in vague general discussions that the opposite view becomes vocal.

Science, it is urged, is the source of all the trouble: and we may look to scientific men for some constructive contribution to finding a remedy. It is worth while to inquire what basis there is for this indictment, and whether, in fact, it is feasible for

men of science to desist from labours which may have a disastrous outcome, or at any rate to help in guiding other men to use and not to abuse the fruits of those labours. I may say at the outset that I have no sanguine contribution to make. I believe that the whole idea that scientific men are specially responsible is a delusion born of imperfect knowledge of the real course of the process of discovery. Indeed, very much the same complaint was made before the scientific era. Let me refer you to Shakespeare's play of *Henry IV* :—

> ' Great pity, so it was
> This villainous saltpetre should be digged
> Out of the bowels of the harmless earth
> Which many a good tall fellow had destroyed
> So cowardly. '

The quotation leads us to inquire how far the further development of this particular kind of frightfulness into modern high explosives was deliberate or not.

In the course of systematic study of the chemistry of carbon compounds it was inevitable that the action of nitric acid on substances like benzene, toluene, glycerine, cellulose and the like should be tried. No one could foresee the result. In the case of benzene, we have nitrobenzene, the key to the aniline dye industry. In the case of glycerine, Sobrero obtained in 1846 the highly explosive liquid called nitro-glycerine. He meant no harm, and in fact his discovery lay dormant for many years, until Nobel turned his attention to the matter in 1863, and showed how by mixing nitro-glycerine with other substances, solid explosives could be made which admitted of safe handling. Dynamite was one of them. They proved invaluable in the arts of peace, *e.g.*, in mining and in making railway tunnels, such as those through the Alps. They were used by the Irish Fenians in the dynamite outrages of the eighties. These attempted outrages were not very successful, and so far as I know no one was inclined to blame science for them, any more than for the Gunpowder Plot. Like the latter, they came to be considered slightly comic. If any one doubts this, he may agreeably resolve his doubts by reading R. L. Stevenson's story *The Dynamiter*. At all events, high explosives had been too long in use in peaceful industry for their misuse to be laid directly to the account of science.

Coming next to poison gas. We read that Pliny was overwhelmed and killed by sulphur dioxide in the eruption of Vesuvius in A.D. 79. During the Crimean War, the veteran admiral Lord Dundonald urged that the fumes of burning sulphur should be deliberately used in this way, but the suggestion was not adopted. Even if it had been, scientific research *ad hoc* would obviously have had little to do with the matter. During the Great War, chlorine was used on a large scale. I need hardly insist that chlorine was not isolated by chemists for this purpose. It was discovered 140 years before, as a step in the inquiry into the nature of common salt.

Coming to the more recondite substances, we may take mustard gas—really a liquid—as typical. It is much more plausible to suggest that here was a scientific devilment, deliberately contrived to cripple and destroy. But what are the real facts ?

Referring to Watt's *Dictionary of Chemistry* (edition of 1894), there is an article of less than forty words about mustard gas (under the heading of dichlordiethyl sulphide). After the method of preparation used by Victor Meyer has been mentioned, the substance is dismissed with the words 'oil, very poisonous and violently inflames the skin. Difference from diethyl sulphide.'

There are sixteen other compounds described at comparable length on the same page. So far as I know, none of them is of any importance. A not uncommon type of critic would probably say that the investigation of them had been useless, the work of unpractical dreamers, who might have been better employed. One of these substances, namely mustard gas, is quite unexpectedly applied to war, and the production of it is held by the critics to be the work not of dreamers, but of fiends whose activities ought to be suppressed! Finally at the bottom of the page begins a long article on chloroform. This substance, as you know, has relieved a great deal of pain, and on the same principle the investigator who produced it was no doubt an angel of mercy. The trouble is that all the investigators proceeded in exactly the same spirit, the spirit that is of scientific curiosity, and with no possibility of telling whether the issue of their work would prove them to be fiends, or dreamers, or angels.

Again, there is the terror of thermite incendiary bombs, spreading fire broadcast through our great cities. The notion is sometimes encountered that thermite was invented for this purpose. Nothing could be further from the truth. I first made acquaintance with it myself in 1901 by hearing a lecture at the Royal Institution by the late Sir William Roberts Austen on 'Metals as Fuel'.[1] He drew attention to the great amount of energy which was liberated when aluminium combined with oxygen, and showed how aluminium powder mixed with red oxide of iron would react violently with it, withdrawing the oxygen from the iron, and becoming brilliantly incandescent in the process. He showed further how this mixture, called thermite, could be used for heating metal work locally, so as to make welds, *e.g.*, in joining two iron pipes end to end. I venture to say that it never occurred to him or to any of his hearers that thermite had any application in war.

In discussions of this kind a distinction is often implied between what I may call old-fashioned knowledge and modern scientific knowledge. The latter is considered to be the special handmaid of 'frightfulness'. The futility of this distinction is easily seen by considering a special case. Iron is thought of as belonging to the pre-scientific era, while aluminium is thought to belong to the scientific era. From the standpoint of chemistry both are metals, and the problem of producing them in either case is a chemical one. When produced they both have their function in 'frightfulness'; iron to cut and stab; aluminium to make thermite bombs to burn and destroy. If modern science makes its contribution to 'frightfulness' in giving us aluminium, ancient craft did so in giving us iron. It is obviously absurd to make any distinction in principle between the two cases. Science properly understood includes all real knowledge about material things, whether that knowledge is old or new.

All these terrors have only become applicable against a civilian population by the development of aircraft. Military objects were certainly not the incentive of the successful pioneers of artificial flight. They were fascinated at first by the sport of gliding, and afterwards by a mechanical transport problem.

It is true that brilliant writers of imaginative fiction, such as Jules Verne and H. G. Wells, had foretold all, and more than all, the horrors that have since come to pass. But it is perhaps more to the point to inquire what were the contemporary views of practical men. The Wrights made their first successful flight in 1903. In 1904 I myself heard the then First Sea Lord of the Admiralty repudiate with scorn the suggestion that the Government were interesting themselves in the matter; and I know with equal definiteness that even as late as 1908 the Chief of the Imperial General Staff did not believe in the military importance of flight. Would it be fair then to blame the inventors for not having realised it, and for not having stayed their hands?

Summing up what may be learnt from the experience of the past, I think we may say that the application of fundamental discoveries in science to purposes of war is altogether too remote for it to be possible to control such discoveries at the source.

For good or ill, the urge to explore the unknown is deep in the nature of some of us, and it will not be deterred by possible contingent results, which may not be, and generally are not, fully apparent till long after the death of the explorer. The world is ready to accept the gifts of science, and to use them for its own purposes. It is difficult to see any sign that it is ready to accept the advice of scientific men as to what those uses should be.

Can we then do nothing? Frankly, I doubt whether we can do much, but there is one thing that may be attempted. The Association has under consideration a division for study of the social relations of science which will attempt to bring the steady light of scientific truth to bear on vexed questions. We rejoice to know that our distinguished American visitors are in sympathy with this aim, and we hope that our discussions with them will bear useful, if modest, fruit in promoting international amity.

[1] *Proc. R.I.*, 1901, Feb. 23, **16**, **496**.

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"Vision" and "War".

LORD RAYLEIGH'S presidential address to the British Association for the Advancement of Science, which was reproduced in *Current Science* for last month, consists of two parts. The first part is devoted to the consideration of the historical development of the auxiliary physical instruments invented by scientists for assisting their natural organs of visual perception for exploration of those phenomena in the material universe which happily lie beyond the faculty of their physiological mechanism of vision. The second part forms a brief but effective defence of scientists who are generally but unreasonably accused of being responsible for all the atrocities of modern wars.

We know that the extremely complicated and delicate human eye is the outcome of a long evolutionary process from some simple and generalised type, and that it is adapted to react to the bulk effects taking place in the environment. The sensory organs have therefore a survival value, for on their power and acuteness depends the individual and communal life. Nature never intended them to be used for the purpose of investigating the atomic structure or the passage and behaviour of electrons. The physical scientist has had to supplement the mechanism of the eye by devices which have supplied its natural deficiency, in a way essentially identical with direct scrutiny. The concept of the universe developed by the scientific worker, equipped with the most delicate and sensitive optical instruments, must necessarily differ from the standpoint of the man, who relies upon his unaided vision and intuition for the interpretation of the phenomenal world, and it is open to the philosopher, taking a general interest in the results of modern science, to conclude that science contradicts the evidence of the senses. The growing feeling for effecting a reconciliation of such apparently contradictory views, must have led Lord Rayleigh to give a historical review of the methods and results achieved by the physicist using the technical apparatus which his inventions have placed at his disposal. In dealing with the increasing employment of optical goods for the investigation of the behaviour of matter in all states, Lord Rayleigh has emphasised that in view of the fact that we have to depend mostly upon our visual perception for the greater part of our knowledge of nature, the means at the disposal of scientists

for improving their devices to carry forward their researches need not be considered as exhausted, and that extravagant optimism about their limitless extension, while theoretically admissible, is not justified having regard to the histologically circumscribed character of the sensory surface of the natural organs. The lenses, telescopes, microscopes, cathode rays, X-rays, spectroscopy, photo-electric surfaces and television certainly promise prospects of future developments, but they form only one gateway of knowledge to obtain world experience, which cannot be complete, because our sense perceptions are extraordinarily vague and confused modes of experience. Modern physical sciences are the product of a co-ordinated effort, carried on through centuries, to investigate those phenomena of nature which produce the transitions of sense perception or awareness, and science has no explanation to offer for the necessity of these phenomena, nor has science the power to endow its formulæ for the observed phenomena with any self-consistent meaning.

In the concluding para of the first part of the address Lord Rayleigh has pointed out that the modern scientific doctrines are not based on speculations or theoretical deductions, but have been built up on the foundation of tangible facts discovered by methods not essentially different from direct scrutiny. This mode of direct scrutiny reveals nature as a vacuous pattern of electrical disturbances, and where the centres of disturbances cohere, the experience of solid state is obtained. You want the biological eye to sense the solids; you want the electric eye to perceive that "a particle can be both a particle and a wave". But is the information provided by the latter "Eye" a complete expression of our experience of the visual field of nature? It seems to us that all sense perception is merely an outcome of the dependence of our experience upon bodily functionings, and that the interpretation of the relation of our personal experience to the phenomena of material universe lies in the examination of the dependence of our personal experiences upon our bodily functionings. We may not be near a direct disclosure of the metaphysical nature of things, nevertheless scientific analysis has revealed enough knowledge to enable man to utilise his discoveries for his good as well as for his evil.

We should have been greatly impressed if Lord Rayleigh had chosen as his text for addressing the British Association the other "Vision", which the great founder of Christian Religion preached about nineteen hundred years ago, and on which the whole structure of European civilization purports to be founded. What is the attitude of the great body of British and American scientists who had gathered at Cambridge to discuss scientific papers, while the Central European powers were talking the language of war. For months extending to years the world has been witnessing stupendous developments in the two continents, threatening every nation to be involved in a general conflagration, which is already devastating two countries. Is there a science of peace? or is there only a science of war? It is true that the British Association convened its annual session at a time when the condition of public affairs in Europe was unpropitious for scientists to define their relation to international politics, but a public pronouncement of their intentions in their collective capacity might have helped to unravel the European tangle. We are aware that in the totalitarian states, scientific knowledge is under conscription for military purposes, and we know the extent of reaction which it must produce on the temper of democracies. Political ideologies are fast infecting the spirit of science. There is no recognisable symptom of the change of heart in Dictators towards the horrors and wastefulness of war in which their policies, if pressed to action, must involve their own countries which they profess to love and adore.

Lord Rayleigh has put the case for scientists thus, "It is worth while to enquire what basis there is for this indictment, and whether in fact, it is feasible for men of science to desist from labours which may have a disastrous outcome, or at any rate to help in guiding other men to use and not to abuse the fruits of those labours". His own opinion regarding the general criticism of the application of scientific discoveries in the methods of modern warfare is summarised in a brief sentence, "I believe that the whole idea that the scientific men are specially responsible is a delusion born of imperfect knowledge of the real course of the process of discovery".

Nobody quarrels with scientific discoveries. Nobody suspects the intentions of scientists. Nobody doubts the urge of scientists to explore the unknown. The world is prepared to accept Lord Rayleigh's plea that scientists are not responsible for all the atrocities of war, but it is entitled to ask "then, who is responsible?" He is perfectly right when he says, "I venture to say that it never occurred to him (Sir William Roberts Austen) or to any of his hearers (Lord Rayleigh included) that thermite had any application in war." But surely some one must have had the necessary vision to discover its application to the destruction of civil populations, and is that "some one" a scientist or a politician or a journalist? But the "world is ready to accept the gifts of science, and to use them for its own purposes. It is difficult to see any sign that it is ready to accept the advice of scientific men as to what these uses should be." The world that Lord Rayleigh has in mind is innocent of dichlordiethyl sulphide and is not likely to mix aluminium powder with red oxide of iron, but they form the material on which a few gifted men work and demonstrate their application to the practical uses in peaceful industry. These scientific men are said to have no notion that the "oil, very poisonous and violently inflames the skin," and the "great amount of energy which is liberated when aluminium combines with oxygen" can have any use for military purposes. We believe that there is a wide difference regarding the degree of responsibility attached to scientists investigating theoretical problems and those dealing with explosives and poison gases, and it is untenable to maintain that the entire school of chemists are innocent of the consequences of the products of their researches to the civil populations, or of the possibilities of their employment for military purposes. Will Lord Rayleigh defend the conduct of a well-meaning educationist who in the exuberance of his enthusiasm produces a tiger from the jungle for the purpose of giving the Sunday School children a lesson in natural history and, losing control over the beast, lets it loose on the unoffending boys and girls? Would the school master be justified, were he to protest that "it never occurred to him that the cattle lifter was also a man-eater". At some stage or other in the course of their investigations, scientists must realise the probable directions in which their discoveries might be used, and must also become aware of the consequences of such applications, because they are reputed to be endowed with far-sighted vision, and their faculty of penetration is undoubted. If scientists apprehend that the "world" is morally still in swaddling clothes, would they be justified in willingly placing that excellent and indispensable instrument, the "penknife" into the hands of that injudicious infant? The fact is that deep down in the unconscious part of their minds, scientists are essentially patriots and their desire to defend their homes with mustard gas is perfectly natural and honourable, because the world has not outgrown the spirit of the ancient saying "that all is fair in love and war". That the symbiosis established between science and war in pre-historic times cannot be easily dissociated is refleted in Lord Rayleigh's concluding sentence, "I think we may say that the application of fundamental discoveries in science to purposes of war is altogether too remote for it to be possible to control such discoveries at the source," and the world must for the moment be satisfied with the confession, "frankly, I doubt whether we can do much".

Dealing with the doctrine of pacificism not from the standpoint of sentimentality, but from the standpoint of the facts of human nature and human environment, Lord Raglan has discussed in his little book *The Science of Peace*, what the historical and biological sciences have to say on the origin, development and prevention of war. We confidently hope that the British Association for the Advancement of Science in collaboration with similar Associations in America and in the European countries will, by the formation of the new Division for the investigation of the social relations of science, succeed in finding a satisfactory solution for the vexed problems agitating the world. To the objective study of the social relations of science inaugurated by British scientists whose ultimate ideal must be the establishment of international peace and harmony, India is capable of making significant contributions. Is there perfect agreement among scientists regarding "results" and "methods" of study of the Social Relations of Science?

Lucknow University Studies.

(Faculty of Science.)

WE have received eight neatly bound booklets from the Registrar of the Lucknow University, containing lectures delivered under the auspices of the faculty of science by professors belonging not only to Lucknow, but also to the Universities of Allahabad and Nagpur. These addresses have been published under the Editorial supervision of Professor B. Sahni, F.R.S., Dean of the Faculty, to whose zeal and initiative, this new feature of extra-mural intellectual activities of the University owes its inception. The addresses cover practically all the departments of knowledge embraced by the faculty of science, and they constitute an impressive record of knowledge useful alike to advanced students and to the junior members of the staff. A complete list of reference works is appended to each series of lectures, which must necessarily enhance their value for students engaged in post-graduate studies.

It is one of the legitimate functions of the Universities to portray the part which they play in representing internationally the intellectual activities of their professors and, in furnishing such a picture, the University of Lucknow has, through its "Studies", made an attempt at an organized means, of co-operation, whose results, though premature to assess, may have a far-reaching importance. The subjects which have been selected for the "Studies" include "The Theory and Constructure of Non-differentiable Functions (A. N. Singh); Recent Advances in Indian Palæobotany (B. Sahni); Nitrogen Fixation and Alkali Soil Reclamation (N. R. Dhar); The General Field Theory of Schouten and Van Dantzig (N. G. Shabde)" and others equally important. The scope of these studies is indicated in the preface attached to each series of lectures, and the subjects selected by the authors have been treated comprehensively. Each author has his own individual plan of presenting his topic, but all conform to the general principle underlying the scheme. The reader will find in these studies an ample banquet, and after tasting its sweets, will rise with an appetite.

"Vitaminised" Foods.

WITH the increasing realisation of the fact, that India suffers from an appalling degree of vitamin deficiency, it becomes imperative that the vitamin resources of the country should be fully and systematically explored and a means found to increase their production. The most economical way of achieving this object would be to improve the "quality" of foods—both vegetable and animal—with respect to their vitamin content. Attempts which have been made in this direction, elsewhere, have yielded highly promising results and should constitute the starting point for planning a more comprehensive scheme of investigation.

Feeding cows with irradiated yeast increases the vitamin D content of milk and this observation has been fully utilised in the production of 'vitaminised' milk, which has proved effective in the cure and prevention of rickets in children. A similar enrichment of the vitamin D has been effected in the case of eggs by feeding poultry with irradiated yeast. It is said that one of these eggs contains as much vitamin D as three teaspoonfuls of cod-liver oil.

The pigmentation of the yolk of eggs has been found to intensify by feeding hens with certain types of foods. Hens maintained on a diet of *paprika* lay eggs with intense colour and a remarkably high carotene content. Experiments with unicellular organisms, like yeast, have shown that the composition of the nutrient medium influences the formation of the ribo-flavin, aneurin and other components of the vitamin B complex. The vitamin content of the food forage crops is influenced by the fertility of the soil and particularly by the presence of certain catalytic elements like manganese and boron.

Different Theories of the Spiral Nebulae.*

By A. C. Banerji and Nizamuddin.
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HUBBLE found that about 97 per cent. of extra-galactic nabulæ fall into two classes which are more or less regular in shape, *viz.*, (*a*) those which have no spiral arms and are "elliptical" in shape, (*b*) those which possess "true spiral" forms each form consisting of a central region which is rather vaguely defined and from which two spiral arms emerge.

The elliptical nebulæ are classified into eight types, namely, E_0, E_1, E_2, E_3, E_4, E_5, E_6 and E_7, the numerical integer being nearest to $10 \cdot \frac{a-b}{a}$, where a and b are the greatest and the least diameters of the projections of the nebulæ on the sky. We may notice here that E_0 nebulæ are almost circular in shape as in this case $b > 0 \cdot 95\, a$.

Among the spiral nebulæ a much larger number consists of a circular nucleus from which two or more spiral arms emerge, whereas in the second type of spiral nebulæ whose number is much fewer the arms appear to emerge from the ends of a bar-shaped mass.

The remaining 3 per cent. of the nebulæ including the two Magellanic clouds are of irregular shape.

The spiral shapes of the nebulæ raise great difficulties and several theories have been suggested to explain them. We shall discuss briefly the more important theories in this paper.

1. *Jeans' Theory.*—Jeans worked out the case of a rotating compressible mass and obtained a series of configurations with increasing rates of rotation. The surfaces of equi-density will clearly coincide with equi-potential surfaces. Here the minor axis OZ is the axis of rotation. Over the boundary we get $\nu + \frac{1}{2}\omega^2(x^2+y^2) =$ constant. Where ω is the angular velocity. If ν_1 be the potential at any point of the equator and v_2 the potential at one of the poles, $\nu_2 = \nu_1 + \frac{1}{2}\omega^2 a^2$ (where a is the equatorial radius). If $\bar{\rho}$ is the mean density and b the polar radius, then $M = \frac{4}{3}\pi\bar{\rho}\, a^2 b$ and $\nu = \frac{\gamma M}{a}$ and $\nu_2 = \frac{\gamma M}{b}$ approximately.

Jeans thus finds that $\frac{4e}{3} = \frac{\omega^2}{2\pi\gamma\bar{\rho}}$ where ellipticity $e = \frac{a-b}{a}$. From observed ellipticity of nebular forms we can find the values of $\frac{\omega^2}{2\pi\gamma\bar{\rho}}$, and a method can be found out for calculating $\bar{\rho}$.

Bok has applied Jeans' method to Roche's compressible model of a massive point nucleus surrounded by an atmosphere of negligible total mass. He has further assumed that this configuration is rotating with uniform angular velocity around the Z axis. As before the surfaces of equi-density would coincide with equi-potential surfaces.

Let us consider the equatorial section of the configuration. We have at the equator if Ω is the total potential $\Omega = \frac{\gamma M}{a} + \frac{1}{2}\omega^2 a^2$. Also if p be the pressure then, $\frac{dp}{da} = \rho \cdot \frac{d\Omega}{da}$. Therefore $\frac{dp}{da} = \rho\left(-\frac{\gamma M}{a^2} + \omega^2 a\right)$.

If a is small then $\frac{\gamma M}{a^2} >> \omega^2 a$ and $\frac{dp}{da}$ is negative, and so this is a stable configuration since p decreases as a increases.

The pressure gradient vanishes for the value a_0, where $a_0{}^3 = \frac{\gamma M}{\omega^2}$, we then get $\Omega_0 = \frac{3}{2}\omega^2 a_0{}^2 = \frac{3}{2}(\omega\gamma M)^{\frac{2}{3}}$

So the equation for the limiting equipotential surface becomes $\frac{1}{2}\omega^2(x^2+y^2) + \frac{\gamma M}{r} = \frac{3}{2}(\omega\gamma M)^{\frac{2}{3}}$.

The critical value of the mean density is obtained from $\frac{\omega^2}{2\pi\gamma\rho} = 0 \cdot 36$.

Bok suggests that for $\bar{\rho} > \rho_0$, the surplus matter would probably stream out in equatorial plane.

* From a lecture delivered at the Mathematical Conference, Lucknow, March 16, 1938.

Jeans supposes that as soon as the ellipsoidal nebulæ becomes unstable, gas will be ejected out in the equatorial plane along the spiral arms and ultimately stars would be formed by condensations along these arms.

The main difficulty in Jeans' theory is that he supposes that ellipsoidal nebulæ by their very nature are gaseous in composition and this is not corroborated by observation. His theory rules out the possibility of star clouds existing in ellipsoidal nebulæ. This is also not verified by observation. Our own galaxy is probably a highly flattened system of ellipsoidal form and is known to contain many star clouds.

Lindblad has also calculated the mass of the Andromeda nebula and he has found that the luminous part of the nucleus is composed mainly of stars like our Sun.

The observed spectra of ellipsoidal nebulæ cannot be explained by Jeans' theory about their composition.

Jeans' theory would give a long-time scale for the age of stars which are believed to be formed in the spiral arms of the nebulæ but Bok has pointed out that long-time-scale presents many difficulties which would disappear if you accept the short-time-scale.

2. *Brown's Theory*.—Brown assumes that originally every spiral nebulæ was a highly flattened homogeneous ellipsoid of revolution inside which the gravitational force of attraction is of the form $-Ax$, $-Ay$, $-Cz$. Later on, minor variations in the uniform density are assumed to be due to perturbations caused by rather close encounters with passing galaxies. These perturbations also lead to the formation of the spiral arms of the nebulæ. Brown further concludes that after the encounter the spiral arms gradually coil up and the nebulæ ultimately reverts to its original ellipsoidal shape. According to him the spiral form is not a permanent structure and its formation is being repeated more or less periodically by encounters.

Inside the homogeneous ellipsoid of revolution all stars will have the same angular velocity. Brown superposes on the uniform density, the additional small density

$\delta_1\sigma = \lambda \cos\left(2\phi - 2q \log \frac{r}{a} - 2\alpha\right) \sin^2\theta$, where $\lambda << \text{constant}$ density. Here r and ϕ are the co-ordinates in the equatorial plane and θ is the angle which the radius vector makes with the polar axis. We now see that $\phi - q \log \frac{r}{a} = \alpha$ is equation to an equiangular spiral.

We may also notice here that the factor $\sin^2 \theta$ in the superposed density leads to rapid density decrease perpendicular to the equatorial plane. Here q is the tangent of the angle which the radius vector makes with the tangent at any point of the spiral. As the superposed density is a periodic term, it may cause the resonance trouble. So in Brown's theory it is necessary to add another term $\delta_2\sigma = -\mu \log \frac{r}{a}$, where μ is of the same order of magnitude as λ. This extra term leads to a gradual density decrease as r increases.

We also find that on account of superposed density the rate of angular motion is slower in the front regions than in the back regions. Hence it leads to the gradual coiling up of the spiral like a watch spring.

Assuming the density of galaxies in intergalactic space to be 10^{-72}, Brown calculates that in every 10^{12} years there will be an encounter which would lead to spiral formation. There is one great drawback in Brown's theory—apart from the small superpositions he assumes uniform density throughout the galaxy even perpendicular to the equatorial plane; but this is not borne out by observation. Moreover there is also no evidence yet to show that spiral formation is a periodic phenomenon.

3. *The Theory of Vogt* ι *l Lambrecht*.—In accordance with this theory most of the mass of the spiral nebulæ is supposed to be concentrated in the nucleus. So that everywhere outside the nucleus the gravitational force may be taken to vary as $\frac{1}{r^2}$, r being the distance from the centre of the nucleus. In addition to the force of attraction they assume that there is also a force of repulsion proportional to the distance from the centre of nucleus. If h is the areal constant, $u = \frac{1}{r}$ and θ is the position angle, we get our equation $\frac{d^2u}{d\theta^2} + u = \frac{\gamma M}{h^2} - \frac{\alpha^2}{h^2u^3}$. From this

we get,

$$\theta + \text{const.} = \int \frac{dr}{r^2 \sqrt{\frac{2\gamma M}{rh^2} + \frac{\alpha^2 r^2}{h^2} - \frac{1}{r^2} + c.}}$$

If α^2 has a small value between 0 and $\frac{\gamma M}{r^3}$ then spiral orbits will be formed. For large values of α^2 convex hyperbolas will result.

Vogt finds that for Andromeda nebula α^2 is small and equal to $\frac{1}{50} \frac{\gamma M}{r^3}$.

Criticism of Vogt's Theory.—The main objection to Vogt and Lambrecht's theory is the assumption of the force of repulsion. They did not give any explanation of its cause. It is analagous to cosmic force of repulsion in Einstein's theory of Relativity which is believed to expalin the so-called phenomenon of recession of g^laxies. The theory does not satisfactorily explain why should there be two arms in the spiral nebulæ. Lambrecht tries to explain it by ascribing it to encounters. Moreover there is no justification in assuming that the mass is concentrated in the nucleus. Hacker has also criticised Vogt's theory. He has pointed out that the spiral orbits would also have a point of inflexion. Moreover the form of the spiral orbit as given by Vogt's theory does not very well agree with the observed spiral arms of the nebulæ. The orbit according to Vogt's theory proceeds rather steeply outwards after reaching the point of inflexion.

4. *Lindblad's Theory.*—Lindblad assumes that there is a small condensed nucleus which is surrounded by a spheroidal galaxy of stars of uniform density from which spiral arms emanate. He takes the mass of the nucleus to be λM and the total mass to be $(\lambda + 1)$ M. For orbits in equatorial plane Lindblad gets the equation

$$\left(\frac{du}{d\theta}\right)^2 = -u^2 + \frac{2}{h^2} \int \frac{f}{u^2}\, du,$$

where $f =$

$$\frac{\lambda\gamma M}{r^2} + \frac{3}{2} \frac{r\gamma M}{a^3 e^3} \left[-\frac{ae}{r} \sqrt{\frac{1 - a^2 e^2}{r^2}} + \text{arc sin } \frac{ae}{r} \right]$$

where e is the eccentricity of the meridional section, a is the semi-major axis and θ is the longitude. f is measured positively towards the centre. The first term in f arises from the nucleus and the remaining terms from the outer ellipsoid of revolution.

After substituion and integration we get

$$\left(\frac{du}{d\theta}\right)^2 = -u^2 + \frac{3}{2} \cdot \frac{\gamma M}{h^2 a^3 e} \left[\left(2a^2 - \frac{1}{e^2 u^2}\right) \text{arc sin } aeu + \frac{a\sqrt{1 - a^2 e^2 u^2}}{eu} + \frac{4}{3} \lambda a^3 eu \right] + c.$$

Lindblad has proved that tidal action will cause a slight perturbation which will not change h but will increase c by a small amount δc. Lindblad has put symbolically the above equation as $\left(\frac{du}{d\theta}\right)^2 = \phi(u) + c$.

If $\frac{1}{u_0}$ be the semi-major axis of undisturbed elliptic orbit just before perturbation, then the spiral form would be possible provided $\phi''(u_0)$ is positive. If $\phi''(u_0)$ is negative no spiral form is possible. So when $\phi''(u_0) = 0$, we get the transitional case. If there be little mass in the nucleus, that is if λ is small, there is great possibility for the formation of the spiral arms.

Lindblad's Recent Investigations.—In a recent paper Lindblad has assumed that the stellar system may be divided into a number of sub-systems of approximately the same extension in the galactic plane but with different degrees of flattening towards this plane and different speed of rotation at the same distance from the axis.

The sub-system of greatest flattening towards the galactic plane is represented by the Milky Way clouds and one of the smallest flattening and smallest velocity of rotation is represented by the distant globular culsters. He also assumes that no given natural system of objects would belong to a single sub-system, but would spread over a number of such sub-systems. Spectro-graphical determinations of the rotational motions of the nebulæ show a fairly uniform angular speed of rotation in the central parts of the systems. It is extremely probable that in the outer less dense regions, the angular velocity is far less than in the central parts and that in these regions it decreases rapidly.

Perhaps the transition between these two states of motion is fairly rapid. Lindblad has shown that asymptotic spiral orbits will naturally occur in such cases. Moreover due to the escape of high velocity objects and formations of condensations all rotating systems will become flattened with age and the condition that is necessary for formation

of asymptotic spiral orbits will automatically be realised after some time.

Lindblad has shown that in the outer regions of the central system there would be a marked tendency towards a formation of local condensation of matter. He suggests that as the result of an encounter between two such condensations near the edge of the spheroidal system, one condensation may move in an asymptotic orbit and cause the "initial disturbance" to produce the spiral form. So according to him tidal ejections due to outside cause such as encounter with passing galaxies, are not essential for the formation of two or more spiral arms.

Lindblad has also suggested, contrary to Vogt, that the points of ejections should have a tendency to recede relatively to the matter at the edge of the central system in opposite direction to the rotation. It is quite possible that these points of ejections may be fixed in space. According to Lindblad when the spiral arms are fairly thin, the decrease of size and mass of the central system may be neglected and spiral arm may without much error be supposed to indicate the real orbit of a single particle of the arm (M. 81). In the case of nebulæ of heavier arms continuous decrease of the central body by the formation of arms must be taken account of and the arm no longer represents exactly the orbit of one of its particles (M. 51).

Lindblad's theory seems to be much more tenable than any other theory so far put forward as he does not make any untenable assumption concerning the structure of ellipsoidal and spiral nebulæ.

Wellman's Theory.—Wellman has assumed that a slow expansion of the system due to a secular decrease of its mass would make all elliptical orbits of the system take the shape of very close spirals. He assumes that there is a difference in the rate of expansion between outer and inner orbits and that the spiral arms are the loci of the ejected matter that comes out as a steady outflow from diametrically opposite points of the system. Although these assumptions are very interesting they can hardly be applied to the actual system.

Jehle has tried to explain the spiral arm by generalised theory of wave-mechanics.

Narlikar and Moghe have suggested that the two-dimensional geodesics of an expanding spherical universe have spiral arms, but their theory has been criticised by McCrea. Narlikar has also replied to the criticisms of McCrea.

In conclusion, it may be mentioned that no satisfactory theory about the formation of spiral arms can be established until and unless we can have a more thorough knowledge of the constitution of the galaxy. The recent investigations by Plaskett and Pearce tend to show that inter-stellar matter extends throughout the local cluster and that there is a gaseous substratum involving the local system and perhaps extending beyond it "a continuum rather than a cloud". They have also found that the inter-stellar diffused matter partakes in the rotation of the galaxy and they believe that the whole galactic system is immersed in a gaseous substratum consisting of atoms of various elements, the density being of the order of 10^{-26}. "The separate atoms while obeying the ordinary gas laws partake in a rotational movement around a distant central mass in galactic longitude 325°. The observed rotational accelerations seem to be the same as for the stars so that the atoms are not subjected to any appreciable radiation pressure from the central mass."

From observational matter now available we may accept the view that the space in our stellar system, at least to the distance observed, is pervaded by very diffuse matter in the gaseous form of a composition similar to stellar matter and ionised by general radiation of stars.

The authors are studying the problem of the spiral arms by assuming a central rotating homogeneous mass of finite dimensions (not small) surrounded by a rotating gaseous and ionised matter of low density, so that apart from the gravitational forces, electrical forces are also to be taken into account.

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Donnan Equilibria in Biological Processes.

By K. R. Dixit.

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The Living Cell as an Osmotic System and Its Permeability to Water.[36]

If the living cell behaves as an osmotic system, we can apply thermodynamics, and the values of the constants like molecular weight obtained by using the cells as osmometers, should agree with those found by means of non-living systems.

A typical mature plant cell may be considered as consisting of a solution of various electrolytes and non-electrolytes (the cell sap) enclosed in a semipermeable membrane, the extremely thin protoplasmic layer (protoplasm). The latter forms a closed sac lying against the semi-rigid cellulose wall (the cell wall) which in most plants is permeable both to water and solute. The pressure exerted by the sap keeps the cell wall under a certain tension to which is due the normal state of rigidity (turgor) of the cell. When a plant cell is placed in pure water or in a solution hypotonic with respect to its contents, entry of water due to end-osmosis is generally prevented by the rigidity of the wall. When on the other hand, a cell is placed in hypertonic solution, exosmosis occurs, the sap diminishes in volume and the encircling protoplasmic layer retreats from the cell wall, which loses its tension. By placing cells of the same kind in solutions of graded concentration it is possible to find for each solution that particular concentration in which plasmolysis is barely perceptible.

H. de Vries[37, 38] using the leaf cells of *Tradescantia discolor* as osmometers determined the molecular weights of raffinose and sucrose. Similarly, the cells of *Spirogyra* were used as osmometers by Overton.

Probably no other kind of animal cell has been as extensively employed for investigation of osmotic phenomena as the red blood cell. These isolated cells are easily obtained at any time and in any desired quantity, they have relatively a simple structure, they can be kept in usable condition for a longer period of time than any other kind of cell, and unlike many other isolated cells erythrocytes show no seasonal variation. Its osmotic properties are perhaps more influenced by slight environmental changes than is the case with any other kind of cell. In common with other cells the erythrocyte is freely permeable to a great variety of organic compounds whereas it is impermeable to salts as such. However, unlike most other cells, the erythrocyte is permeable to many anions, so that the exchange of anions may take place between the cell and its surrounding medium. For example, it is well known that HCO_3^- when its amount increases in the blood corpuscle, is exchanged for Cl^- from the plasma. Hamburger[39] first established the fact that the relative osmotic pressure of solutions may be determined by using the erythrocyte as osmometer. Equally convincing experiments were performed by Kœppe,[40] Hedin,[41] and others.

As in the case of plant cells it is possible with a muscle to determine the strength of a solution in which the muscle neither gains nor loses water (a solution which is isotonic with the muscle). Such experiments show that both plant and animal cells obey the laws of osmosis (based on thermodynamics) so long as they remain alive and uninjured, *i.e.*, as long as the semipermeability of their surfaces is preserved.

Similar experiments have been performed with leucocytes and spermatozoa,[42–44] muscles such as the gastrocnemius or sartorius of frogs,[45] with certain plant cells of regular geometrical form like the parenchymatous cells of the stem of *Tradescantia elongata*,[46]

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36 Lucké and McCutcheon, *Physiological Reviews*, 1932, **12**, 68.

37 H. de Vries, *Zeit. Physik. Chem.*, 1888, **2**, 415.

38 H. de Vries, *Bot. Zeit.*, 1888, **46**, 394.

39 Hamburger, *Arch. F. Physiol.*, 1886, 476.

40 Kœppe, *Zeit. Physik. Chem.*, 1895, **16**, 261.

41 Hedin, *ibid.*, 1895, **17**, 164.

42 Hamburger, *Archiv. F. Physiol.*, 1898, 317.

43 H. Kœppe, *ibid.*, 1895, 154.

44 H. Kœppe, *ibid.*, 1899, 504.

45 R. Beutner, *Biochem. Zeit.*, 1913, **48**, 217.

46 K. Höfler, *Ber. deutsch. Bot. Gesellsch.*, 1917, **35**, 706.

with yeast cells,[47] and also with egg cells of Echinoderms, *Arabacia punctalata*.[48]

Cramer[49] has formulated the problem of permeability of water as follows: "Is the water content of the living cell dependent entirely on osmotic forces or is it dependent also on the inhibition of the lyophilic colloids of the cell content?" In the former case, the water would be entirely free, in the latter a fraction of water would be bound and incapable of taking part in osmotic exchange. Gortner,[50] however, points out that there is 'an insensible gradation from water which is an integral part of protoplasmic structure to that which is simply the medium in which the protoplasm is suspended'.

It is well known that electrolytes play a prominent rôle in the properties of cells. The effect of low concentrations of electrolytes on permeability to water has been investigated by the use of unfertilised *Arabacia* egg.[51] These experiments clearly showed that chlorides of univalent cations tend to increase permeability to water, while those of bivalent cations tend to reduce permeability, to its value in sea-water. It is reasonable to infer that the low permeability values obtained in sea-water are dependent on the presence of Ca and Mg.

Effect of activation (fertilisation) of echinoderm eggs on the permeability to water has been investigated, and of the many chemical and physical changes that occur in the egg cell on fertilisation, its increased permeability to water-soluble and diffusible substances is regarded by Lillie[52] as of fundamental importance. Evidences of such permeability change, quoted by Lillie, are increased electrical conductivity, the readier entrance of substances like alkali and certain dyes, the loss of certain substances (*e.g.*, pigment), from the fertilised egg, and the fact that pure isotonic solutions of sodium salts, which are known to increase permeability and to serve as activating agents, do neither in the presence of calcium or magnesium salts or anæsthetics.

In this connection the observation of Loeb[53] is recalled that parthenogenetic agents are in general cytolytic ones. This is true of the pure salt solutions and acids (*e.g.*, butyric) ordinarily used to activate the egg artificially, as well as agents less often used, such as electric currents, heat and mechanical stimulation. Lillie sees a close connection between the activating effects of these agents and their stimulation of irritable tissues. In the case of both activation and stimulation he regards the first step as the increase in permeability of the cell surface, as the result of which occurs a change in electrical polarisation; electrical changes, he regards, as the critical phenomena which brings about either activation or stimulation.

Lillie also concludes that fertilised eggs are several times more permeable to water, than are unfertilised ones. The increase in permeability is not instantaneous. It begins probably 2 to 4 minutes after insemination and is in greater part completed during the next 10 minutes.

The permeability of the unfertilised egg of the seaurchin, *Arabacia*, is about 0·1, in the fertilised state it increases two to four times, while the permeability for the human red corpuscles is of the order of magnitude 3·0. In membranes of living systems an extreme range of permeability is found from practically complete impermeability to free permeability. Thus, under certain conditions, the membrane of the egg of Fundulus is practically impermeable to water; the other extreme is found in the cellulose wall of many plant cells which permit free diffusion of water.

Donnan Equilibrium in Blood Corpuscles.[19,20]

E. Warburg[15] was the first to apply the theory of Donnan Equilibria to red blood-corpuscles, and considerable progress has been made during the last few years.[16, 17] It is well known that the red corpuscles do not possess any nucleus, and as a result the metabolic processes are either completely absent or play an unimportant part. Further these cells are impermeable by micellæ and simple cations like Na^+, K^+ but are permeable to anions like HCO_3^-, Cl^-. Thus all the necessary conditions for Donnan

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[47] K. T. Wieringa, *Protoplasma*, 1930, **8**, 522.

[48] McCutcheon and Lucké, *Journ. Gen. Physiol.*, 1931, **14**, 393.

[49] W. Cramer, *Trans. Farad. Soc.*, 1930, **26**, 686.

[50] R. A. Gortner, *ibid.*, 1930, **26**, 678.

[51] McCutcheon and Lucké, *Journ. Gen. Physiol.*, 1928, **12**, 129 and 571.

[52] R. S. Lillie, *Amer. Journ. Physiol.*, 1916, **40**, 249.

[53] J. Loeb, *Science*, 1913, **37**, 427.

equilibrium are apparently fulfilled, and this equilibrium condition between the liquid within the cell and the serum outside it may be represented diagrammatically as follows:

$$
\begin{array}{llll|llll}
\multicolumn{4}{c|}{\text{Red corpuscle.}} & \multicolumn{4}{c}{\text{Serum.}} \\
\text{Hb} & & & & & & & \text{P} \\
\text{Hb}^- & \left.\begin{array}{l} \\ \\ \\ \end{array}\right\} & B^+ & \left\{\begin{array}{l} a \\ b \\ c \end{array}\right. & \begin{array}{l} x \\ y \\ z \end{array}\left.\begin{array}{l} \\ \\ \\ \end{array}\right\} & B^+ & \left\{\begin{array}{l} \\ \\ \\ \end{array}\right. & \begin{array}{l} \text{P}^- \\ \text{Cl}^- \\ \text{HCO}_3^- \end{array} \\
\text{Cl}^- & & & & & & & \\
\text{HCO}_3^- & & & & & & & \\
\multicolumn{4}{c|}{(1)} & \multicolumn{4}{c}{(2)}
\end{array}
$$

where B^+ = sum of the cations Na^+ and K^+.
Hb = hæmoglobin.
Hb^- = hæmoglobin anions.
P = serumprotein.
P^- = serumprotein anions.

a, x, etc., are the concentrations.

The red corpuscle also contains other proteins besides hæmoglobin, but they are present in such small quantities that they may be neglected in an approximate calculation. Further in order to simplify the calculations, we shall assume that both the solutions are dilute and ideal or the simple theory of Donnan[4] can be applied to the system.

Hence

$$\frac{(Cl^-)_1}{(Cl^-)_2} = \frac{(HCO_3^-)_1}{(HCO_3^-)_2} = \frac{(Cl^-)_1 + (HCO_3^-)_1}{(Cl^-)_2 + (HCO_3^-)_2} = r,$$

where the brackets denote as usual the molar concentrations. With the same assumptions the conditions of the osmotic equilibrium give the following relation

$$(B^+)_2 + (Cl^-)_2 + (HCO_3^-)_2 = (B^+)_1 + (Cl^-)_1 + (HCO_3^-)_1 + (Hb)$$

where (Hb) is the total concentration of hæmoglobin in the cell. These two relations give for r the following relation:

$$r = \frac{b+c}{y+z} = 1 - \frac{a + (Hb) - x}{2(y+z)}$$
$$= 1 - \frac{a + (Hb) - x}{2[(B^+)_2 - x]}.$$

A study of the chloride and bicarbonate distribution between plasma (venous) and spinal fluid, and plasma and ascitic fluid has been made by Muntwyler, Way and Pomerene[54] and they conclude that the concentration and distribution of electrolytes in body fluids are governed by the factors outlined for the Donnan equilibrium. But their results as well as those of Hastings and others[55] show that $\frac{(Cl^-)_1}{(Cl^-)_2}$ is slightly less than $\frac{(HCO_3^-)_1}{(HCO_3^-)_2}$ which means that the conditions for the simple Donnan equilibrium are nearly but not exactly fulfilled. But this is what could be expected for in the simple theory we assume that both the solutions are very dilute and ideal, and we neglect the possibility of the formation of the ioncomplexes as well the adsorption of the ions. For a better agreement, more exact theory will have to be developed.

We have seen that the red corpuscles are not permeable by the cations, but Robinson and Hegnauer,[56] performed experiments with the plasma of cats and rabbits (which have received large intraperitoneal injections of isotonic glucose) and they conclude that when the electrolyte balance of the plasma is sufficiently altered, the red blood cell membrane may become somewhat permeable to cations.

Physico-Chemical Factors Affecting Intra-ocular Liquid.[57]

The earliest conception of the nature of the intra-ocular fluid was that it represented a secretion by the epithelium of the ciliary body, a conception based on insecure and inadequate evidence, mainly anatomical in nature. During the last thirty years there has existed alongside this view, the theory that the fluid in the anterior chamber was formed by simple filtration from the capillaries of the eye. Later physico-chemical researches of Duke-Elder[58] have given rise to the theory that this fluid is essentially a dialysate. We shall describe here the work of Duke-Elder[58] in detail.

The constituents of the serum are present in the intra-ocular fluid, these constituents may be divided into three groups of substances depending on the physical state of their molecules in solution, colloids, non-ionised and ionised crystalloids. All the substances

[54] Muntwyler, Way and Pomerene, *Journ. Biol. Chem.*, 1931, **92**, 733.

[55] Hastings, Sendroy, McIntosh and Dvan Slyke, *ibid.*, 1928, **79**, 193.

[56] Robinson and Hegnauer, *ibid.*, 1936, **116**, 779.

[57] W. S. Duke-Elder, *Physiological Reviews*, 1934, **14**, 483.

[58] Duke-Elder, *Biochem. Journ.*, 1927, **21**, 66.

in colloidal aggregation are found in the intra-ocular fluid, but in much less concentration than in serum; proteins, fats, immune bodies and ferments. All the proteins of the plasma are found in the intra-ocular fluid, they are found here in the same relative proportions in which they occur in blood, and they are specifically identical. They thus appear to remain unchanged in their transit from the blood-vessels to the eye. The diffusible non-dissociated substances are partitional between the intra-ocular fluid and the blood serum in approximately equal amounts. The more important constituents are sugar urea and the non-protein N. The dissociated diffusible substances are unequally distributed. In each case the cations have a partition coefficient > 1, and the anions a partition coefficient < 1, the former being in less and the latter in greater concentration in the intra-ocular fluid than in the serum. Cations are Na, K, Ca and Mg and the anions are Cl′, SO_4'' and PO_4'''.

Duke-Elder finds that the osmotic pressure of the intra-ocular fluid is less than that of the capillary plasma by an amount determined by the excess of colloids in the latter. It is a small fraction only (about 0·3 to 0·5 per cent.) of the total osmotic pressure (approximately 6,000 mm. Hg).

Duke-Elder also studied the intra-ocular fluid formed under abnormal conditions :

(1) In the first series of experiments the permeability of the capillary walls is altered. He finds that when the permeability is increased very definite changes take place in the chemical and physical properties of the intra-ocular fluid, which are essentially the same no matter what method is employed to alter the permeability. The fluid so formed differs from the normal by approximating more nearly to the constitution of the plasma. The colloidal non-diffusible substances—proteins etc., are increased. The colloidal non-diffusible substances which are not ionised, such as sugar, are practically unchanged in concentration. The ionised salts are partitioned unequally; the negatively charged anions show a diminution, and the positively charged cations an increased concentration. In a similar way physical properties vary in the direction an excess of colloids would lead us to expect.

(2) In the second method Duke-Elder altered the composition of the blood, either by varying the concentration of the normal constituents or by adding new substances to it. (This is of importance from the point of view of the local availability of drugs in the eye.) He finds that colloidal substances enter the eye, only in traces, if at all. Diffusible substances which are not ionised enter the eye freely, rapidly attaining therein a concentration equal to that in the plasma. Diffusible substances which are ionised behave in a manner depending on their electric charge. Anions—negatively charged substances like chlorides—readily pass into the eye, but cations do so only with difficulty.

Duke-Elder[59] analysed this experimental data, and assumed that the simple theory of Donnan may be applicable to this system. If Donnan's theory is applied the condition of equilibrium could be diagrammatically represented as follows :

Capillary blood.		Aqueous humour.
P		
Na^+ $\begin{cases} P^- \\ Cl^- \end{cases}$		Na^+ Cl^-
(1)		(2)

where P = protein. This gives the theoretical relation

$$(Na^+)_{aq.} \times (Cl^-)_{aq.} = (Na^+)_{blood} \times (Cl^-)_{blood}.$$

Duke-Elder[59] found experimentally that L.H.S. = 148·8 and R.H.S = 149·3, which is a very satisfactory agreement with the theory.

Based on this experimental data, the theory of dialysation was elaborated by Duke-Elder; that the intra-ocular fluid is in thermo-dynamical equilibrium with the capillary blood, and is a dialysate of it, the dialysing membrane being the capillary walls. It is thus comparable in its origin and metabolism with the tissue fluids elsewhere, and differs from them qualitatively only as a consequence of the relative impermeability of the capillaries of the eye. The capillaries vary in their permeability throughout the different tissues of the body, being adapted to suit the needs of each particular organ, and their almost complete impermeability in the eye may

[59] Duke-Elder, *The Nature of Intra-ocular Fluids*, London, 1927.

be regarded as a biological adaptation to keep the intra-ocular fluid as far as possible free from colloidal substances so that it remains optically homogeneous.

Swelling of Protein Gels.[20]

The swelling of proteins is a subject of exceptional importance. The swelling of silk, cotton and wool fibres, of cellulose, and of various other plant and animal tissues, are the examples of this type of swelling. We have to deal with this type of swelling in the various manufacturing and biological processes.

A dry leaf of gelatin will, when placed in pure water, take in water and swell. This phenomena of imbibition-swelling can be prevented by applying pressure to the gel, and this equilibrium swelling-pressure may reach very high values when the gel contains only a relatively small proportion of the solvent. The nature of the intra-micellar or extra-micellar forces that determine this taking in of water are not yet fully understood. There exists, however, an apparently different sort of swelling, which we may call secondary or osmotic swelling. A piece of gelatine which has been fully swollen in pure water will show a further and much greater swelling in dilute acid or alkaline solutions. The forces concerned here are not great and a relatively small pressure is sufficient to prevent this type of protein swelling.

Procter and Wilson[60–62] consider this as a special case of Donnan's general theory of membrane equilibria. When gelatin is immersed in a dilute solution of an acid, combination takes place between gelatin molecules and the hydrogen ions, resulting in the formation of an highly ionisable salt of gelatin (formation of a non-diffusible gelatin cation), the anion of which is tending to diffuse, and exerts on the jelly mass an outward pull, which produces an increase in the volume of the jelly proportional to the magnitude of the pull. In pure water, combination must take place, although probably only to a very slight extent between the gelatin molecules and the hydrion of the slightly dissociated water, leaving in the jelly a corresponding excess of hydroxyl ions which tend to diffuse outward causing the jelly to swell. According to the simple theory of Donnan the ionic products on each side of the jelly-water interface are equal, but the sums of the diffusible ions in the two systems are unequal. This inequality of the diffusible ions in the two systems causes an osmotic pressure in the jelly, which is greater than the osmotic pressure in the external fluid. This osmotic excess is the force which causes the jelly to swell, there is also a counterforce due to the elastic properties of the framework.

Procter carried out experiments to verify the theory. He assumed that the gelatin salt is completely ionised. If GH^+ represents the gelatin ions, *i.e.*, gelatin molecules combined with H^+, the state of equilibrium is represented diagrammatically as below:

Jelly.		External solution.	
z	$G\,H^+$		
y	H^+	H^+	x
$y+z$	Cl^-	Cl^-	x

and $y(y+z) = z^2$. Procter found that this equation is satisfied qualitatively.

On the quantitative side the original Procter-Wilson theory gives only a rough approximation and requires modification in the light of later knowledge.[63] Procter-Wilson theory of gelatin swelling is based on the Donnan equations,[4] and these were worked out for diffusion into a volume sufficiently large, or for very dilute ideal solutions only. Experiments carried out on such systems show that as soon as structure begins to appear in a system, the simple calculations based on Donnan's equations[4] can no longer be applied in their unmodified form.

Donnan's original equations start with the assumptions that though the colloid ion is under mechanical restraint, all other ions and molecules are free from mechanical restraint. This hypothetical case is realised in a system where a membrane divides an entirely fluid system, *i.e.*, where the colloid is a sol, but as soon as we turn to consider gels, a different state of affairs make itself manifest. Ions and molecules can diffuse

[60] H. R. Procter, *Journ. Chem. Soc.*, 1914, **105**, 313.

[61] Procter and Wilson, *ibid.*, 1914, **109**, 307.

[62] Wilson and Wilson, *Journ. Amer. Chem. Soc.*, 1918, **40**, 886.

[63] D. Jordon-Lloyd, *Journ. International Soc. Leather Trades' Chemists*, 1933, **17**, 208.

through weak gelatin jellies as freely as through water, but as soon as the gel has a setting concentration of more than about 15% this is no longer the case, and by a time a 20% setting concentration is being considered, the hindrance to the migration of both water and dissolved substances is being considerable. In the tissue such as a muscle there is about 25% of protein and there is still a fair amount of freedom of movement for small molecules and swelling due to the establishment of Donnan equilibria takes place in acid and alkaline solutions. In skin where the protein concentration has increased to 35%, the freedom of movement of small molecules is still further reduced and the osmotic swelling is reduced accordingly. When we come to the group of fibres which in equilibrium with water contain 25 to 30% of water to 75 to 70% of protein, the structural arrangements of the long protein molecules must be such that nothing but long, fine capillaries remain for the small molecules to diffuse through, and the rate of diffusion is impeded. The mere crowding together of protein molecules leads to a reduction of the space available for free water and calls for the introduction of new and unknown factors into the simple equations.

Ionic Nature of Enzymes.

The Donnan equilibrium furnishes a test for the ionic nature of any diffusible substance,[64] since the ratio of the concentration of any ion on the two sides of a membrane must be equal to the ratio of the concentrations of any other ion of the same sign and valence, whereas a non-ionic substance would be equally distributed on both sides. Expressed mathematically the equation is

$$\frac{(A_0{}^{-n})^{1/n}}{(A_i{}^{-n})^{1/n}} = \frac{(B_i{}^{+m})^{1/m}}{(B_0{}^{+m})^{1/m}} = \frac{(C_i{}^{+l})^{1/l}}{(C_0{}^{+l})^{1/l}}$$

in which (A_i) is the concentration of an n valent negative ion inside the membrane, (A_0) is the concentration of the same ion outside. B, C, etc., are any other diffusible ions present, having the valence m, l, etc. In order to test the ionic nature of a substance, therefore, it is only necessary to set up such an equilibrium system, measure the concentrations of some ion such as hydrogen or chloride and compare this ratio with the concentration ratio of the substance under investigation. The only difficulty lies in the fact that the equation predicts only the concentration of the ions and not the total concentration, so that if the substance is not completely ionised, or is combined in non-ionic form in the solution, the determination of the total concentration will not lead to the correct ratio. In other words, if the experimental results do not agree with the ratio, the discrepancy may be due to complicating factors and no definite conclusion can be drawn, whereas if they do agree, the conclusion seems justified that the substance is ionic.

Northrop applied this method to the distribution of trypsin and found that trypsin behaves like a monovalent positive ion from pH 2 to 10·2.[64] At this point it behaves as though it were unionised and on the alkaline side of 10·2 becomes a monovalent negative ion. The experiments in this strongly alkaline range, however, are not satisfactory. Northrop[65] has also found that the ratio of the concentration of pepsin inside of gelatin or egg albumin particles to the concentration outside is approximately equal to the ratio of chloride or bromide ion under the same conditions. This is true over the range of pH from 1 to 7, and in the presence of various salts and acids. It follows, therefore, that pepsin is monovalent anion, and also that the enzyme does not form a compound with gelatin nor is the degree of dissociation affected by changes in pH in the range in which the enzyme is active. The enzyme becomes very unstable on the alkaline side of pH 7.

We shall now describe certain reactions which at least qualitatively can be explained on the basis of Donnan's theory. For example, it has long been known that dilute solutions of certain electrolytes will stimulate the action of enzymes. Falk[66] showed that dilute solutions of $MnSO_4$, $MnCl_2$, $MgSO_4$, $CaCl_2$ and $BaCl_2$ increased the activity of castor bean lipase toward ethyl butyrate. Calcium and magnesium salts accelerate tryptic digestion,[67] aluminium sulphate and monophosphates in dilute

[64] J. H. Northrop, *Journ. Gen. Physiol.*, 1924, **6**, 337.

[65] Northrop, *ibid.*, 1925, **7**, 603.

[66] Falk, *Journ. Amer. Chem. Soc.*, 1913, **35**, 601.

[67] Cole, *Journ. Physiol.*, 1904, **30**, 202 and 281.

solution have been found to stimulate enzyme activity,[68] potassium bromate in low concentrations stimulates the digestion of casein by trypsin.[69] Not only is it possible to stimulate the activity of enzymes with salts but their presence is also capable of increasing enzyme production by microorganisms.[70]

In a series of papers dealing with the properties of an *antistaphylococcus* phage and its mode of action on a strain of *Staphylococcus aureas* Krueger[71] has shown that: In a mixture of phage and growing bacteria, phage in or on the cells is in equilibrium with the phage free in the medium. Phage formation is intimately related to bacterial growth and as far as can be determined does not occur in its absence. Phage can be completely inactivated by high concentrations of $HgCl_2$ and subsequently can be reactivated by removal of the Hg^{++} ions. Similarly inactivation with KCN can be reversed by conversion of the CN^- into $Ag(CN^-)_2$.

Krueger and West[71] performed experiments in connection with the accelerating effect of manganous salts on phage action. These experiments show that the accelerating effect is not due to a stimulation of bacterial growth nor to an enhancement of phage formation. There is a clear-cut lowering of the lytic threshold and also a change in the distribution of the phage between the bacterial cell and its environment. The Mn^{++} ion increases extracellular fraction at the expense of the phage fraction associated with the cell.

Padoa and Tedeshi[21] attempted to determine the membrane potential of oxidase and peroxidase (which are Fe and Mn containing the enzymes) in contact with an ionisable salt of the same ions. They find that under proper experimental conditions it is possible to determine at which pH the Mn^{++} ceases to act as a catalyst, it is between pH 6·2 and 6·4.

Physico-chemistry of Cheddar Cheese Making.

McDowall and Dolby[72] find that there is a definite evidence of the existence of a Donnan equilibrium which controls the partition of ions between curd and whey and which also involves an osmotic effect which determines the concentration of non-electrolytes after salting. They show that after salting there is a pronounced fall in the concentration of calcium, a much less pronounced fall in phosphate and lactate, and a rise in sulphate in the wheys. With curd salted at an earlier stage than the normal, the whey contained a higher concentration of lactate/water, than did the whey from another portion of the same curd which had not been salted. Summing up these results it can be said that after salting there is an osmotic diffusion of water, from the curd tending to dilute all constitutents of the whey, while there is also a membrane effect which tends to increase the concentration of anions and decrease that of cations.

We can explain these results if we imagine a curd particle as being surrounded by a membrane permeable to all ions but protein ions, we obtain the conditions necessary for a Donnan equilibrium. It may be shown, theoretically, for such a case that the addition of an electrolyte such as sodium chloride will produce a rise in concentrations of cations in the outer liquid. The outward diffusion of water may be another result of this equilibrium or may be a simple osmotic diffusion due to the slow rate of diffusion of salt into the curd. The concentration of sodium chloride inside and outside the particle may be brought into equilibrium either by an outward diffusion of water or by an inward diffusion of sodium chloride. Until equilibrium is established, which may require some hours, both forms of diffusion will probably take place. Much of the water which diffuses out will escape as whey and will contain the various whey constituents in a more dilute form than prior to salting.

The Donnan equilibrium will have an important effect in determining the relation of the lactic acid in the curd to the whey acidity at all stages of the process. Any factors affecting this equilibrium will thus alter the significance of the whey acidities as a means of determining the extent of lactose fermentation in the curd. Among the factors controlling the equilibrium is the ionisation of the curd protein. This will be affected by the pH and also probably by other factors such as heat and rennet action, which alter the nature of the protein. It seems possible that in this equilibrium lies

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[68] Schneidewind, *et al.*, *Landwirt. Jahrb. Schweiz.*, 1906, **35**, 911.

[69] Falk and Winslow, *Journ. Biol. Chem.*, 1918, **33**, 453.

[70] Robbins, *Amer. Journ. Bot.*, 1916, **3**, 234.

[71] Krueger and West, *Journ. Gen. Physiol.*, 1936 **19**, 75.

[72] McDowall and Dolby, *Journ. Dairy Research*, 1936, **7**, 156.

the key to the anomalous acidity readings mentioned by McDowall and Dolby.[72]

Membrane Equilibria in Soil Physics.

Lemmermann and Wiesmann[73] have found that the plants are better able to assimilate phosphoric acid from the soil, if the soil contains silicic acid, probably in colloidal form. Stollenwerk[73] working with Naaki observed that the manures in the form of potassium and phosphoric acid, can be used more economically when mixed with pure natural silicic acid. Silicic acid, SiO_2, which is negatively charged was of great help to the plants in the assimilation of food, whereas the positively charged iron hydroxide, $Fe(OH)_3$, hindered the assimilation of food. Stollenwerk[73] also carried out some experiments on marshy soil, making use of the solubility of the silicic acid in humic acid. It appears that the presence of the colloidal substances in the soils leads to a large yield, *i.e.*, to a better assimilation of food. Applying the Donnan equilibrium to the process we see that the colloids which are undissociated and non-diffusible help the dissociated substances to diffuse into the plant. Stollenwerk's experiments also appear to indicate that singly charged cations are more easily taken in the plant in the presence of colloids than the doubly charged cations.

Similar experiments carried out by Behrens and Robertson[74] show that H ions are exchanged when neutral salts react with acid sphagnum peat. An equivalent entrance of the cation into the peat does not take place in this reaction. In some cases there is an increase in the cation concentration of the salt solution, in other cases there is an increase in the anion concentration. The influence of the concentration and the nature of the cations and anions upon the reaction suggested that the exchange might be explained on the basis of the establishment of Donnan equilibrium between the neutral salt solution and the acid peat.

Colloidal Phenomena in Plants

Colloidal systems involve small divisions of matter which expose large surfaces. The particles are, however, many times larger than the molecules so that ordinary molecular and ionic chemical reactions of the dissolved substances, are largely replaced by physical and chemical reactions dependent upon surface forces. A liquid colloidal system is a sol and a solid or a semisolid system a gel. The protoplasm of plants consists of colloidal systems varying from emulsions (sols) to moderately stiff gels. The solid substances of protoplasm proteins, dextrins, gums, etc., are characterised by the readiness with which they form colloidal systems in water.

The property[22] of not being permeable to substances dissolved in the cell sap is preserved by protoplasm only as long as it is alive. As soon as protoplasm dies, it loses its impermeability, and the substances dissolved in the cell sap diffuse out. The loss of impermeability by the killed cell results from changes in the state of the colloids of the protoplasm. From the condition of a sol they are transferred to that of a gel, the degree of their dispersion decreases, and their micellæ form irregular aggregates, between which, canals readily accessible to water and solutions are opened. This phenomena is called coagulation. The coagulation of protoplasm may be brought about by different causes, such as high temperatures, poisons, salts of heavy metal, acids, alkalies, as well as by an excessive withdrawal of water or even by mechanical pressure. In all cases coagulation leads to the death of the protoplasm. The phenomena of coagulation is, however, peculiar not only to protoplasm and albuminous substances in general, but also to other colloids of emulsoid and suspensoid character.

In many instances protoplasm may be dried to a state of complete air desiccation when usually 10 to 12 p. c. of the so-called hygroscopic moisture remains without losing its vitality, *i.e.*, the faculty of returning to the sol condition. Thus seeds which in the ripening lose all free water and being air dry simultaneously suspend all vital processes, when moistened, once more return to activity. The same is true of many cryptograms, such as mosses, lichens, and some ferns. Not only their organs of reproduction but the whole thallus of these plants may be reduced to an air-dry condition. They return to activity when moistened. In such a dried protoplasm, therefore, some processes must be going on which alter the dispostion of its particles. When stored for a very long period, dry seeds lose their power of geminating. Under similar conditions dried cryptograms lose their capacity of returning to

[73] W. Stollenwerk, *Zeit. Anorg. All. Chem.*, 1937, **231**, 192.

[74] Behrens and Robertson, *Zeit. Pflanzenernähr, Düngung Bodenkunde*, 1931, **23 A**, 50.

life. Similar coagulation is observed when photographic plates are kept for a long time, their emulsion gradually becomes more and more coarse-grained and the plates lose their sensitivity to light.

All biological processes are characterised by life and the living cell is really a physico-chemical transformer which assimilates various substances and maintains itself in a state of dynamical equilibrium. Naturally many of the problems involving the application of colloidal physics and chemistry to protoplasma and plant physiology are but imperfectly understood. Still it has been possible to explain a large number of biological processes, at least qualitatively, by the application of Donnan equilibrium. Donnan considers an active living cell. In such a cell assimilation of substances oxidation and decomposition are taking place. The products of decomposition are excreted from the cell. In short the cell is continually changing its state. Now let us suppose that all the processes in the cell are stopped only for an instant. We are supposing that the cell is momentarily dead. To such a cell we can apply the laws of thermodynamics. Actually, however, the cell is continuously working. Our procedure in applying the laws of thermodynamics to the living cells is thus similar to the principle of virtual work.

The most essential facts about a living cell[75] are (*a*) its power of specific reproduction and repair, (*b*) its capacity for apparently purposive response and (*c*) its continual exchange of materials and energy. We know of no living organisms which remain indefinitely in a state of equilibrium without the liberation of energy. Life, in fact, is a self-perpetuating series of events: if the continuity of these events be broken by depriving them for a time of energy, their normal progress may be completely altered or prevented. We shall close this article by saying with Donnan.[76] 'Physical chemists were quite prepared to deal with stationary states—and have often done so—and would drop no tears if a rather naive thermodynamical treatment did not provide a complete explanation'.

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75 A. V. Hill, *Trans. Farad. Soc.*, 1930, **26**, 667.

76 F. G. Donnan, *ibid.*, 1930, **26**, 675.

Received June 26, 1938.

An Automobile Factory in India.

At the recent conference of the Congress Ministers for Industries held in New Delhi, Sir M. Visvesvaraya, who attended the meeting by special invitation, presented his important scheme for the manufacture of automobiles in India. India, in 1937, imported 16,036 cars and 13,046 commercial trucks, totalling 29,082 vehicles whose value is estimated at 8 crores. This is one of the 'Key' industries which would pave the way for the manufacture of aeroplanes and armaments, so essential for the country's defence.

The scheme provides for the production of 10,000 cars and 5,000 trucks when the plant attains its maximum capacity. In the early stages, however, it is considered economical to import 30 per cent. of the special parts. 18 to 24 months would be required to put the factory into operation. In the first year, the factory will devote itself to assembling imported parts, some of which will be locally manufactured in the second year, and in the third year, the factory is expected to attain its full size and to manufacture the scheduled number of cars.

150 Lakhs is the proposed capital on which a 20 per cent. return is expected. The Government of India's unstinted support by way of a high protective tariff and generous patronage, is essential for the promotion of the industry. Other progressive governments in the West have allowed similar concessions, the import tariff levied in those countries ranging from 50 to 80 per cent.

The creation of an Automobile Industry in the country necessarily leads to the establishment of several other specialised industries. The car has some 2,000 separate parts and these are provided by the special factories. The Volvo Company of Sweden which manufactured a little over 6,000 cars in 1937, had contracts with 100 Swedish firms for the supply of parts. In India, this industry will use local steel and various other raw materials. It will thus help to develop mechanical skill of the highest order among Indian workmen. It will give employment to technically skilled young men. A factory like this established in the country will develop in our engineers and experts, capacity to design and operate high class machine industries of every kind including locomotives and aeroplanes.

Mr. D. N. Wadia.

MR. D. N. WADIA retires in the last week of October, as Officiating Superintendent of the Geological Survey of India, which organisation he served with conspicuous ability and distinction for a period of $17\frac{1}{2}$ years.

He belongs to the band of pioneer Indian scientists who were self-made in the sense that they taught themselves the intricacies of the science they professed and rose to eminence through devotion to work. Hailing from Gujarat, Mr. Wadia graduated from the Bombay University and joined the teaching staff of the Prince of Wales College, Jammu, where he was Professor of Geology (and latterly Principal) for a period of 13 years. After the War, in 1921, he left the placid academic atmosphere of the College and joined the Geological Survey at the request of Sir Thomas Holland who was then the Member in charge of Industries in the Governor-General's Executive Council.

Indian geology is the richer for his joining the official Survey of the country, for his work has brought to light the structure and tectonics of the North-West Himalaya in Kashmir, Gilgit and Hazara. The elucidation of the geology of a large part of Kashmir including Poonch, of the Nanga Parbat area and of the remarkable syntaxis of the North-West Himalaya—to mention only the high lights of his work—will ever stand to the credit of this scientist. In these pioneering studies, Mr. Wadia has covered an area well nigh 12,000 sq. miles in extent of difficult mountainous country between the Potwar Plateau of the Punjab and the snow-clad Zanskar Range of the Central Himalaya.

In 1919 appeared the first edition of his *Geology of India for Students*. In spite of the technical jargon that is inevitable in a work of this nature, this well-known manual is an eminently readable and fine piece of scientific writing with abiding literary qualities. It has trained a whole generation of Indian students in the complicated stratigraphy of this country and has worthily taken the place of the official 'Manual' by R. D. Oldham. A completely revised third edition of this work is now in the press and is expected to be published within the next few weeks.

While in Jammu, Mr. Wadia suffered a bereavement in the loss of his only child. But he found solace in the company of his wife, a lady of great charm, simplicity and generous impulses. She used always to accompany him in the field and share the difficulties of camp life. But, four years ago, he was denied even this solace when Mrs. Wadia suddenly took ill and died in camp, far away from the reach of friends and of medical help. He has borne this irreparable loss bravely and maintained his characteristic calm; none but his more intimate friends know of the suffering which these bereavements have inflicted on him.

Mr. Wadia is so well known in the scientific circles not only of this country but also abroad, that it is superfluous to dilate on his personal qualities. His great devotion to science, his wide cultural interests, his simplicity, helpful disposition and quiet dignity have won him high regard from all who have come into contact with him. He is retiring from service full of academic honours. He is a founder member of the National Institute of Sciences and the Indian Academy of Sciences; a Fellow of the Royal Asiatic Society of Bengal and of the Geological and Geographical Societies of London. He was President of the Geological, Mining and Metallurgical Society of India for the years 1936 to 1938. His services to Indian Geology have been recognised fully by his scientific colleagues who elected him President of the Geology Section of the Indian Science Congress in 1921 and again for the Jubilee session in 1938.

It is with great pleasure that we have heard that the Government of Ceylon has invited him to be their Government Geologist after he retires from service in India. We wish him godspeed in his new work and offer him the best wishes of the scientific world in India for a long life of activity in his retirement.

LETTERS TO THE EDITOR.

The Earliest Solution of the Biquadratic.

THE oldest complete solution of the biquadratic is attributed to Ferrari (1522–65). He is supposed to have solved the equation $x^4 + 6x^2 - 60x + 36 = 0$, proposed as a challenge to mathematicians of his time. The historians[1] of mathematics have been for some time familiar with a solution of a biquadratic by Bhaskara (1150 A.D.), an Indian mathematician. But the principle of his method hidden away in a numerical example deserves to be made explicit. Bhaskara solves

$$x^4 - 2x^2 - 400x = 9999$$

by adding to both sides $4x^2 + 400x + 1$ so as to make them perfect squares. This method can be easily generalised thus:

Suppose $x^4 + qx^2 + rx = s$.

Add to both sides $ax^2 - rx + b$ and choose a, b so that both sides may be perfect squares.

Then, we have

$$x^4 + (a + q)\,x^2 + b = ax^2 - rx + (s + b)$$

and the conditions to be satisfied by a, b are

$$(a + q)^2 = 4b,\quad r^2 = 4a\,(s + b).$$

Bhaskara has guessed a and b; but we may eliminate b and get a as a root of the *cubic*

$$a^3 + 2a^2q + a\,(q^2 + 4s) - r^2 = 0$$

exactly the same as the one due to Descartes (1637). The roots of the biquadratic are obtained by solving

$$x^2 + \frac{a + q}{2} = \pm\ \sqrt{a}\left(x - \frac{r}{2a}\right).$$

So far as we know, Bhaskara's is the earliest attempt at the solution of the biquadratic and is in line with the later solutions of Ferrari, Vieta and Descartes, though, of course, the *cubic* was not there. At a period when even the negative root was admitted with great hesitancy, it is no wonder that imaginary roots should have been regarded as spurious and unfit to mix with the other numbers. Bhaskara therefore naturally recognised only the real positive root of his biquadratic and did not think of the others.

A. A. KRISHNASWAMY AYYANGAR.

Maharaja's College,
Mysore,
September 12, 1938.

[1] *History of Hindu Mathematics*, Part II, by B. Datta and A. N. Singh. (Motilal Banarsi Das, Lahore, 1938.)

The Magnetic Susceptibility of Dilute Sodium Amalgams.

THE magnetic susceptibility of dilute sodium amalgams has been studied by the Curie method. Mercury and sodium were both distilled in vacuum and the amalgams prepared, were transferred to small pyrex bulbs which were sealed in vacuum. Since the entire work was done in the absence of air, there was no possibility of the results being vitiated by oxidation or absorption of impurities by the amalgam. Values of the susceptibility were obtained at five

field strengths and their average taken. Water was taken as the standard substance and its susceptibility was assumed to be $-0\cdot720$ (in 10^{-6} units) at room temperature (30° C). The concentration of sodium in the amalgam was determined by treating it with water and estimating the hydroxide obtained by titration against standard hydrochloric acid.

The values obtained with pure mercury and pure sodium are given below. These values are in satisfactory agreement with those of other authors, also given below for comparison.

Mercury.

Authors.	χ
Owen[1]	$-0\cdot184$
Davis and Keeping[2]	$-0\cdot189$
Vogt[3]	$-0\cdot168$
Bates and Tai[4]	$-0\cdot1675$
Bates and Baker[5]	$-0\cdot1675$ (at 30° C.)
Bhatnagar and Nevgi[6] (for purified and distilled mercury)	$-0\cdot157$
Bhatnagar and Nevgi[6] (for mercury obtained from extra-pure compounds)	$-0\cdot172$ (Average)
Author	$-0\cdot166$

Sodium.

Authors	χ
Honda[7] and Owen[1]	$+0\cdot51$
Sucksmith[8]	$+0\cdot59$
McLennan, Ruedy and Cohen[9]	$+0\cdot59$
Lane[10]	$+0\cdot65$
Author	$+0\cdot57$

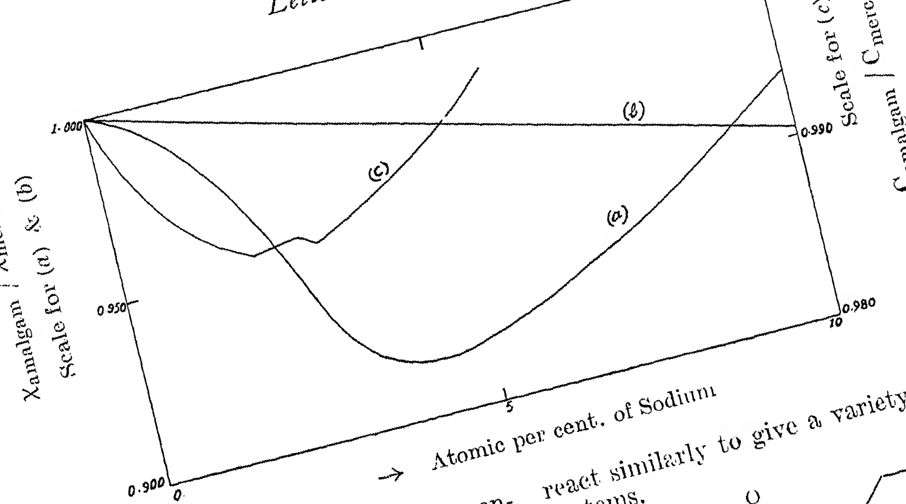
Twenty dilute amalgams were studied having concentrations below $1\cdot3$ per cent. by weight of sodium. The variation of the susceptibility with concentration is shown by curve (*a*) in the figure. The concentration plotted along the X-axis is expressed in atomic per cent. of sodium in the amalgam. It is found that as the concentration of sodium is increased, the diamagnetic susceptibility decreases, at first slowly and then more rapidly. A flat minimum is obtained at a concentration of about $4\frac{1}{2}$ atomic per cent. of sodium. At larger concentrations, the diamagnetic susceptibility of the amalgam increases gradually.

The straight line graph in the figure represents the concentration-susceptibility variation in accordance with the law of additivity. Comparison of the two curves shows that there is considerable departure from this law.

When minute quantities of sodium are added to the amalgam, the sodium goes into solution. W. Kerp and co-workers[11] found for the percentage solubility of sodium in mercury the values of $0\cdot65$ at 25° C. and $0\cdot86$ at 65° C. This corresponds to an atomic percentage of $5\cdot5$ at room temperature. In the graph, the minimum susceptibility is obtained at a concentration very near this value. It is possible, therefore, that the initial fall in the diamagnetic susceptibility is due to the solution of sodium in the mercury.

When larger quantities of sodium are added to mercury, it is likely that solid compounds of sodium and mercury are formed. Several such compounds are supposed to exist and some of them have been claimed to have been isolated. In such cases it is possible that the paramagnetic contribution of the free electrons in the atoms disappears and the diamagnetic susceptibility increases. These compounds of mercury separate and float on the surface of mercury in the form of pasty masses. In our experiments, we found that while at concentrations below about 5 atomic per cent. different samples taken from the same stock amalgam gave nearly identical values, at concentrations above 5 per cent., large differences were obtained. This may be attributed to the non-homogeneity of the amalgam with comparatively richer sodium content.

In this connection it may be pointed out that the electrical conductivity of dilute sodium amalgams, at first decreases with increase of sodium content, reaches a minimum and then increases as has been shown by Davies and Evans.[12] Curve (*c*) in the figure has been adapted from their results. The minimum point of this curve, however, occurs between 2 and 3 atomic



per cent. (*c* in the figure stands for conductivity.)

Investigations on dilute amalgams of the other alkali elements are in progress. Full data will be published elsewhere.

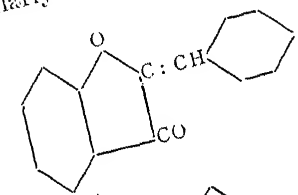
S. ARAVAMUTHACHARI.

Annamalai University,
Annamalainagar,
October 5, 1938.

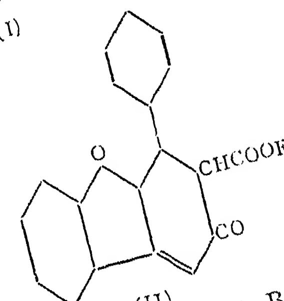
1 *Ann. der. Phys.*, 1912, **37**, 657.
2 *Phil. Mag.*, 1929, **7**, 145.
3 *Ann. der Phys.*, 1932, **14**, 1 ; 1935, **21**, 791.
4 *Proc. Phys. Soc.*, 1936, **48**, 795.
5 *Ibid.*, 1938, **50**, 409.
6 *Curr. Sci.*, **6**, 53.
7 *Ann. der Phys.*, 1910, **32**, 1027.
8 *Phil. Mag.*, 1926, **2**, 21.
9 *Proc. Roy. Soc.*, 1927, **116**, 468.
10 *Phil. Mag.*, 7th Series, 1929, **8** (1), 345.
11 *Mellor's Treatise*, **4**, 1010.
12 *Phil. Mag.*, 1930, **10**, 569.

Benzylidene-Coumaranones considered as Chalkones.

CHALKONES which contain the group − CO–CH = CH −, undergo as is well known a variety of condensation reactions with acetoacetic ester and other compounds containing the reactive methylene group next to a keto-group. We have now found that benzylidene-coumaranones (I) behave like chalkones and condense with acetoacetic ester to give compounds of the type (II) and also with desoxybenzoin, cyclohexanone and flavanone. It is probable that benzylidene-flavanones which also contain the group − CO–CH = CH − will react similarly to give a variety of new ring systems.



(I)



(II)

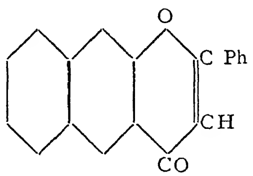
T. B. PANS...
T. S. WHE...

Royal Institute of Science,
Bombay,
September 19, 1938.

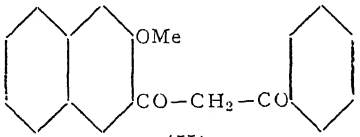
Synthesis of Linear Naphtha...

BOTH the angular α- and β-nap... have long been known ; the... linear naphthaflavone (I) h... achieved, by condensing met... 3-naphthoate with acetophen... divided sodium in presenc... and heating the resulting be... 3-naphthoylmethane (II) ... bromide in acetic acid ... ferric chloride no longer ... (I) with sodium ethoxide...

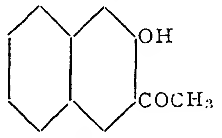
acetonaphthone (III) for which a relatively convenient synthesis is thus provided. Compounds in which the phenyl group in (I) is replaced by naphthyl can be obtained similarly.



(I)



(II)



(III)

V. V. VIRKAR.
T. S. WHEELER.

Royal Institute of Science,
Bombay,
September 21, 1938.

[1] Kostanecki and Ludwig, *Ber.*, 1898, 31, 2951.

The Electric Double Layer, an Effective Potential Barrier for the Accumulation of the Solute at Surfaces of Solutions of Capillary-Active Electrolytes.

WHEN the surface of an aqueous solution of a capillary-active electrolyte is allowed to age, an oriented adsorption film is developed in which the ionised group of the capillary-active ion is pointing towards the solution and the hydrophobic part is projecting into the free space above. This brings about a redistribution of the ions in solution giving rise to a diffuse electric double layer on the solution side of the interface. Simple calculations show that the electric double layer presents an effective potential barrier for further accumulation of the capillary-active ions, especially when the adsorption film is of the gaseous type. Thus, when the surface of a solution of a paraffin-chain salt (giving rise to a gaseous adsorption film) is allowed to age, there should be a sudden surge in the fall of surface tension at start and this should be followed by a slow fall thereafter. This is in accordance with the findings of Adam and Schute.[1] With the capillary-active electrolytes giving rise to a condensed film, the effect of the electric double layer would be comparatively small (though not negligible) in the initial stages and become very considerable when the surface is nearly full. These conclusions are also in harmony[2] with the data on the rate of accumulation at surfaces of aqueous solutions of benzopurpurine 10 B. The accelerating influence of neutral salts on the variation of surface tension with time, noticed by Adam and Schute also receives an adequate interpretation on the basis of this concept. The slowing down of the accumulation with increase in pH, in the case of benzopurpurine 10 B solutions[2] is also explained. The details of these investigations, as well as a discussion of the denudation of the solution just below the surface layer observed by McBain[3] will shortly be published.

K. S. GURURAJA DOSS.

Department of Chemistry,
Central College,
Bangalore,
September 15, 1938.

[1] Adam and Schute, *Trans. Farad. Soc.*, 1938, **34**, 758.
[2] Doss, *Kolloid Z.*, 1938, **84**, 138.
[3] McBain, *Nature*, 1936, **137**, 659.

Bromination of Aliphatic Ketones.

DIRECT bromination of ketones in the absence of catalysers with excess of bromine does not seem to have been attempted except in a few cases like acetone and diacetyl. Several ketones were brominated by us by the general method of keeping the ketone in contact with excess of bromine for four days. Practically in all the cases the reaction is accelerated, after the absorption of a small portion of the bromine added which requires in some cases 30–45 minutes. The reaction mixture is cooled from time to time by means of cold water. After four days about 300 c.c. of water are added to the reaction mixture and the excess of bromine is removed by blowing air into the mixture. The resulting product, if liquid,

TABLE I.

No.	Name of the ketone	Bromo-ketone	Yield (purified product) %	M.P. °C.	B.P. at 4 mm. °C.
1	Acetone $CH_3CO.CH_3$	$C_3H.O.Br_5$	28	72–73	
2	Methylethylketone $CH_3CO.CH_2CH_3$	$C_4H_4O.Br_4$	44	54	
3	Diethylketone $C_2H_5CO.C_2H_5$	$C_5H_7O.Br_3$	81	..	90–93
4	Dipropylketone $C_3H_7CO.C_3H_7$	$C_7H_{11}O.Br_3$	78	..	120–123
5	N-dibutylketone $C_4H_9CO.C_4H_9$	$C_9H_{15}O.Br_3$	65	..	121–123
6	*Iso*-dibutylketone $(CH_3)_2CH.CH_2 \diagdown CO$ $(CH_3)_2CH.CH_2 \diagup$	$C_9H_{15}O.Br_3$	70	..	129–132
7	Capron $(CH)_3(CH_2)_4 \diagdown CO$ $CH_3\ (CH_2)_4 \diagup$	$C_{11}H_{19}O.Br_3$.	65	..	162–165
8	Diacetyl $CH_3CO.CO.CH_3$	$C_4H_2O.Br_4$	60	94	
9	Acetonyl-acetone $CH_3COCH_2.CH_2COCH_3$	$C_6H_2O.Br_8$		181	
10	Pinacoline $CH_3CO.C\ (CH_3)_3$	$C_6H_{10}O.Br_2$	66	69	

is distilled under reduced pressure and if solid, is fractionally crystallised from ether. The analyses of the bromo-compounds were in good agreement and some of them have not been described before. They have a penetrating odour attacking the eyes and are soluble in the common organic solvents. The quantity of bromine taken should be in excess for the elimination of every hydrogen atom in the ketone as hydrobromic acid and replacement of the hydrogens so removed by bromine. The results obtained have been recorded in Table I.

It can be seen that irrespective of the length of the chain and the number of hydrogen atoms, only a few of the hydrogen atoms are replaced by bromine. With ketones containing more than one carbonyl group the number of hydrogen atoms replaced by bromine is much greater. There appears to be an empirical relationship between the number of hydrogen atoms that are replaced by bromine, and the hydrogen atoms, adjacent to the carbonyl groups. The number of hydrogen atoms replaced by bromine is equal to the number of hydrogen atoms adjacent to carbonyl groups less as many as there are carbonyl groups. We are testing this relationship with a few more ketones.

S. V. SHAH.
D. G. PISHAWIKAR.

Department of Chemistry,
Rajaram College,
Kolhapur,
July 16, 1938.

"Knife Cut" at the Base of the Peduncle of Sorghum.

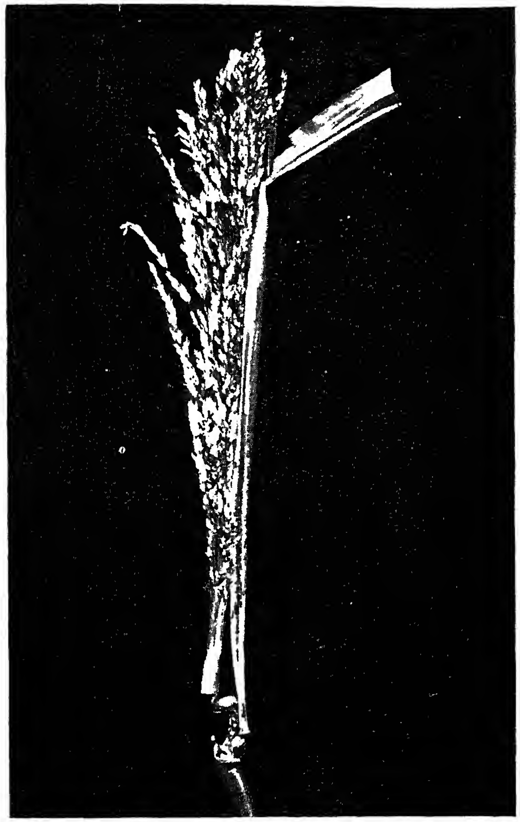
J. P. MARTIN[1] describing abnormal growths of sugarcane refers to the occurrence in association with stem galls of "Knife Cut"—an extremely interesting symmetrical cut which usually occurs on the internode

immediately above the bud. This abnormal condition, he states, is often found below the growing point on the very young internodes.

A rare and interesting instance of a "Knife Cut" has been met with in Sorghum. This occurred in one of the lines of Sudan grass bred for fodder value and got down from the All-Union Research Institute of Plant Breeding—Section of Forage Plants, Odessa, U.S.S.R. In this line, from a third to a fourth of the population gave plants with knife cuts at the base of the peduncle. These cuts appear above the bud and root zone and on the side away from the leaf-bud and at the intercalary growing zone which is always the softest and therefore the weakest spot in sorghum stalks. In high winds it is here that the heads snap. Whenever knife cuts occurred, the heads had not emerged full and clear out of the leaf-sheath. The tip of the head or a portion thereof was always stuck up and held fast within the grip of the inrolled apex of the ultimate leaf-sheath—the sheath bearing the flag. The cause of the cut is obviously the arrest in the free emergence of the panicle.

In the breeding of Sudan grass for better fodder purposes, it looks as if some sweet sorghum blood, probably *S. bicolor* in origin, has been infused into this grass. The characteristic of Sudan grass is a loose sparse-flowered ear-head, a very long peduncle, a thin leaf-sheath and a slight overlap of the leaf-sheath flaps and consequently a fairly loose hold on the peduncle. A study of a few sweet sorghums with *S. bicolor* blood shows that the heads are relatively compact, the emergence fair, the leaf-sheaths thick and tough with a $1\frac{1}{2}$ overlap on the stalk. An examination of the leaf-sheaths in this "Knife Cut" family shows that the average thickness of the dry leaf-sheath is 1·2 mm. as against 0·5 mm. of the leaf-sheath of pure Sudan grass. It looks therefore that in this line, there is a misfit between the leaf-sheath and earhead equipment, finding expression in the mutilation under record. Like goose necking, this character manifests only under optimum conditions. When the earhead manages to escape the impediments in its emergence, the cut does not appear.

A number of measurements were taken of the lengths of leaf-sheaths and of the peduncles in plants with and without the knife cut. In the normal plants the average length of ten leaf-sheaths is 27·4 cm. and the average length of peduncles up to the base of the earhead is 31·0 cm. In plants with the knife cut, the leaf-sheath length is similar to the normal leaf-sheath length, but the peduncle length is only 10·2 cm. ranging from 3 to 22 cm. At the longer end, the knife cut is shallow and at the narrow end, the cut gapes out till it makes very nearly a right-angular dent (see photograph). With the heads stuck up in the



"Knife Cut" at the base of the Peduncle of Sorghum.

top cone of the leaf-sheath and the intercalary growth very vigorous, the stalk snaps at the weakest spot and exposes the cut base through a lightly overlapping leaf-sheath base. There are varieties with poor emergence and with heads stuck up in their boot; but no knife cut accompanies this condition as the general emergence keeps pace with the intercalary growth vigour. But with the wild blood of Sudan grass the heads have to be aloft and the inter-

calary growth has therefore to be extremely vigorous.

This unlooked for consequence is a poignant reminder to the sorghum breeder about the possible repercussions of an otherwise sound breeding programme.

G. N. RANGASWAMI AYYANGAR.
B. W. X. PONNAIYA.

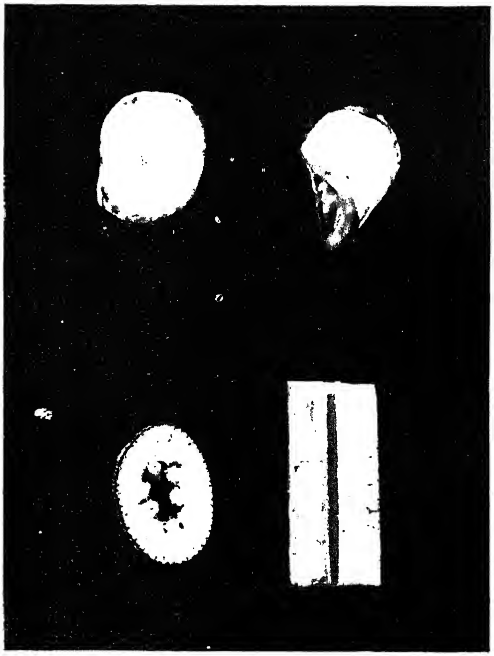
Agricultural Research Institute,
Coimbatore,
Septmber 20, 1938.

[1] *Proc. Fourth Cong. Int. Soc. Sugarcane Technology*, 1932, Bull. 73, 19.

The Occurrence of Hollow Grains and Hollow Peduncles in Sorghum.

MOST of the members of the Graminæ are characterised by having hollow stems. A tubular internodal equipment affords maximum strength with minimum material. Most of the wild sorghums have pithy lower internodes but their peduncles are not entirely pithy. In the top of the peduncle up to a length of about 5 cm. below the base of the panicle the internodes are hollow. There is a tendency for slightly hollow peduncle tops to occur in the Caffra and in the Nervosa sub-series[1] of sorghum. In the cultivated grain sorghums all the internodes and the peduncles are entirely pithy. Sorghum is a cereal that has been evolved both for grain and for fodder and hollow internodes would be a misfit in the scheme of their evolution.

An examination of the foreign grain sorghums under study reveals the fact that varieties from China belonging to the group *S. nervosum* are hollow in the tops of their peduncles; so also the African grain sorghums belonging to the group *S. nigricans* from Tanganyika, N. Rhodesia and Belgian Congo. These two groups of sorghum have grains that are soft when compared with the hard grains of *S. durra* and the flinty grains of *S. cernuum*. Of the two groups, the *nigricans* group is the softer. In this group of sorghum (in which the grains are mostly chalky[2]) there is a hollow in the centre of the grain at the dough stage. This hollow is clear in one particular family, *viz.*, A.S. 4660, which has fairly big grains. In this, the peduncle also showed the hollow fairly well. Longitudinal and transverse sections of these hollow grains and hollow peduncles are given in the accompanying photographs. The hollow grains are like the normal ones till the milky stage. When they reach



Transverse and longitudinal sections of the Grain and Peduncle in *Sorghum nigricans*. Family No. A. S. 4660.

the dough stage the starch is not formed in the centre of the grain but leaves it hollow. As the grains ripen, the top of the grain wrinkles and in some cases a slight pitting also occurs. The hollow inside the grain ranges from a minute cavity to one 3 mm. in length. As the peduncles of the grain sorghums are thick, the hollow is often seen over the entire length of the peduncle.

The concurrent occurrence of this hollow in both the peduncle and in the grain of some of the soft chalky grained sorghums from Africa and China is very interesting.

G. N. RANGASWAMI AYYANGAR.
V. NARAYANAN.

Millets Breeding Station,
Coimbatore,
September 26, 1938.

[1] Snowden, *The Cultivated Races of Sorghum*, 1936.
[2] *Ind. Jour. Agric. Sci.*, 1934, 4, 96.

REVIEWS.

The Evolution of Physics. By Albert Einstein and Leopald Infeld. (The University Press, Cambridge), 1938. Pp. 319. Price 8*s*. 6*d*.

This book is a welcome addition to that class of scientific literature which has for its aim the presentation of recent physical concepts to those who are not specialists in physics but who are nevertheless anxious to understand the advances in scientific thought. In the words of the authors their object in writing the book has been "to sketch in broad outline the attempts of the human mind to find a connection between the world of ideas and the world of phenomena". A perusal of the book makes it clear that they have succeeded in this attempt. The book is particularly free from the usual defects of books intended to popularise science; for instance, there is not a single misleading analogy in the whole book. One who wants to benefit by reading it must take pains and provided he does take pains there is nothing too technical in it that would stand in the way of his understanding the topics dealt with in the several chapters. The book is divided into four chapters. The first is styled "The Rise of the Mechanical View". Here we have a clear presentation of what may be called the older classical physics. In the second chapter with the heading, "The Decline of the Mechanical View", the reader is introduced to the electric and magnetic field theories and the wave theory of light. In the earlier part of the third chapter there is treated the field theory of electric phenomena, the result of the work of Faraday, Maxwell and Herts. In the latter half of this chapter both the special and general theories of relativity are treated in a charmingly interesting and clear manner. Chapter four under the name "Quanta" contains an account of the more recent aspects of physical theory.

The aim of theoretical physics has been described by the authors as follows: "We want the observed facts to follow logically from our concept of reality. Without the belief that it is possible to grasp the reality with our theoretical constructions, without the belief in the inner harmony of our world, there could be no science. This belief is and always will remain the fundamental motive for all scientific creation." The treatment of the subject has been so planned as to bring home to the reader that this aim runs throughout the evolutionary history of theoretical physics.

We have no hesitation in heartily recommending the book to the general reader who is anxious to get an insight into modern theories in physics. B. V.

The Fine Structure of Matter. By C. H. Douglas Clark. Vol. II, Part III. *The Quantum Theory and Line Spectra.* (Chapman & Hall, Ltd., London), 1938. Pp. lxxii + 459–643. Price 15*s*. net.

This is Part III of the second volume of a comprehensive treatise on atomic and molecular structure. It is the object of the author to bring together the various fields of research which have shed light on the structure of matter so that by their juxtaposition a more comprehensive outlook may be possible. Accordingly, he deals with crystal structure, electric moments, atomic and molecular spectra and the Raman effect, each of which is a vast field of specialised study. As the author says, "an individual author is apt to regard his own point of view as capable of explaining all the results of experiment, and a wider outlook is necessary". So "the present work has accumulated together in one place many of the facts which should be taken into account, references being supplied where the treatment is not full". The part before us deals with atomic spectra, with Bohr's theory and the vector model serving as the bases for the interpretation. The treatment is mostly descriptive and qualitative, some necessary mathematical derivations being relegated to an Appendix. The author is naturally fascinated by the music of numbers which permeates spectroscopy and some space is devoted to exhibit a large number of numerical relationships, particularly between the various energy units usual in this part of the subject. The exposition of Hund's theory of spectral terms is lucid and adequate. The experimental results obtained by the

analysis of the spectra of the elements in various stages of ionisation are set forth in detail. The whole existing literature up to the end of 1935 has been thoroughly combed and the extensive lists of references will be of great use to workers in the field. The discussion of the connection between the ground states of atoms and valency is fresh and interesting. The book is a very useful source of information to all those interested in knowing the results which have been obtained in various fields of research, without any great need of mathematical details.

We may mention a few oversights here and there. On p. 485 a and b are called major and minor axes instead of semi-major and semi-minor axes respectively. It is also there stated that for $n = 3$, $k = 1$ corresponds to a circular orbit and $k = 3$ corresponds to the most eccentric ellipse while the reverse is true. On p. 527 we find Russell, Shenstone and Taylor for Russell, Shenstone and Turner. On p. 546 it is stated that the separation of F terms is less than D terms, and that of D terms less than for F terms, where the last F should be P. There are also some misprints on pp. 491, 528, 531, 538, 610 and 638. In connection with Burger and Dorgelo's summation rule for intensities of spectral lines it would have been better if Sommerfeld and Hönl's formulæ were also given. These minor matters do not in the least detract from the merit of the book which may be recommended to all desiring a full account of the results achieved in the field dealt with.

T. S. S.

Elementary Practical Physics. By Newton Henry Black and Harvey Nathaniel Davis. (New York: The Macmillan Company), 1938. Pp. viii + 710. Price 8*s*. 6*d*.

This is not a text-book of laboratory experiments but a book which deals with the Physics met with in practical everyday life. This is the type of book we should like to see in the hands of every S.S.L.C. student to correct a bias towards cramming so easily possible in our examination-ridden country, where what a student studies in school has so little connection with his later life. The book starts with everyday appliances and builds up the principles of Physics by an appeal to the student's experience of these appliances. It succeeds admirably in arousing the interest of the student and succeeds also in making him understand the essential principles of the subject. Though the standard of mathematics used is well below the attainments of an S.S.L.C. student, a very useful account of the most modern developments such as atomic structure, Radio, Talkies and Television is brought within his reach. The illustrations simply make one love the book, so numerous and beautiful are they. The problems and questions will surely make the student think, not from the compulsion of an impending examination, but from an inner necessity of satisfying a curiosity aroused in him. The binding will stand the roughest usage. On the whole, the book is admirably suited to give the student an intelligent understanding of his surroundings and may confidently be recommended for use in academic as well as technical courses involving an introduction to the principles of Physics. Some peculiarities in the book, *e.g.*, the use of gravitational units throughout, necessitating such formulæ as $F = \frac{Wv^2}{gr}$ for centrifugal force, or the definitions of specific resistance and electrochemical equivalents, may look rather unfamiliar. The solution of a problem in impact on p. 221 by making use of the principle of conservation of energy may lead to misconceptions. The statement on p. 641 that Sir William Ramsay first discovered helium in the Sun is not quite correct. But these are minor matters which may be overlooked while recommending an excellent book.

T. S. S.

Electron and Nuclear Physics. By J. Barton, Hoag. (Chapman & Hall, Ltd., London), 1938. Pp. 502. Price 20*s*. net.

The present volume is the enlarged edition of the author's *Electron Physics* published in 1929. The book is roughly divided into four parts. The first nine chapters covering 222 pages deal with Electron Physics. The next six chapters covering 132 pages deal with Nuclear Physics. The next four chapters covering 96 pages deal with modern experimental technique of high vacuum, high voltage, small currents and detection of particles and radiation, such as counters and expansion chambers and ionisation chambers. The last part in 9 pages

gives a large number of problems, under each of the 19 chapters.

Simple statements of the experimental facts and physical principles of both the newer and older concepts are recognised as being of great help in bridging the gap between the early study of physics and the specialization of advanced research.

A successful effort has been made to develop the subjects in such a sequence as to avoid reference at any point to discussions which appear later in the book. The early chapters treat of the electron, its charge, mass, wave-length and emission from hot and cold surfaces. These are followed by chapters dealing with electrical phenomena specific to the outer parts of the atom. In succeeding chapters there are discussions of the phenomena involving the nuclei of the atoms, such as positive rays, natural and artificial radioactivity, transmutations, etc. There is unity about the whole book, because many basic relations and experimental techniques are common to several of these fields of study.

A speciality of the book is a detailed description of some basic and important experiments at the end of each chapter. The apparatus has been simplified from the original research form to an extent which avoids the expenditure of too much time or effort, yet permits an insight into actual work.

No student of physics, engaged in advanced studies or research can well be without this excellent book, thoroughly practical but fully equipped with the necessary theoretical background.

B. DASANNACHARYA.

Hurricanes, their Nature and History. By Ivan Ray Tannehill. (Princeton University Press, Princeton, New Jersey, U.S.A.), 1938. Price $ 3·50.

The word "hurricane" is generally used by meteorologists and seamen in two different senses—one to denote any wind of speed of greater than about 65 miles per hour and another to denote the cyclonic storms of certain tropical and subtropical regions of the earth, for example, the South Pacific, South Indian and North Atlantic Oceans. The word is used in the latter sense in this book. In essence, the hurricanes of the West Indian Seas are not different in character from the cyclones of the Indian seas or the typhoons of the China Seas or the baguios of the Philippines. They all come under the general class of "tropical cyclones". Although there are many papers and memoirs on tropicl cyclones, books on the subject are few, two of the best known being Eliot's *Handbook of Cyclonic Storms of the Bay of Bengal* and Cline's *Tropical Cyclones*. A new book dealing in a general way with the whole subject is therefore very welcome. The chief of the Marine Division of the United States Weather Bureau with his exceptionally large experience of cyclone warning work in America has here presented us with an authoritative and lucidly written account of this fascinating subject.

The book may be broadly divided into two parts—the first part dealing with the characteristic phenomena of tropical cyclones, their places of origin, direction and speed of movement, the changes of pressure, wind and rainfall associated with their passage and the nature of warnings issued by the Weather Bureaus for the safety of life and property on sea and land. Cyclones of different parts of the world come under consideration; those of the Indian Seas, being well-known and having been carefully studied for nearly a century, receive a good deal of attention.

Among the most terrible effects of some tropical cyclones is the inundation of low coastal areas or river-basins by the storm-wave which sometimes accompanies the passage of the cyclonic centre from sea to land. The risk of this is greatest in regions where there is an enclosed sea and a rising sea-bed and on occasions when the entry of the storm-centre happens to coincide with a high tide. Many instances of disastrous storm-waves have occurred in the deltaic area round the head of the Bay of Bengal, the most notable one having been associated with Backergunge Cyclone of 1876 when the storm-wave rose to heights of 10 to 40 ft. over the islands and low banks near the mouth of the river Meghna, and caused a loss of life of over 100,000. The author has not been forgetful of the beneficial effects of cyclones—he quotes an estimate of Newham that in the Puerto Rico hurricane of 1899, the total mass of water precipitated as rainfall on

that island alone was about 2,600 million tons. Some of the Bay of Bengal cyclones have been responsible for the distribution of over 40,000 million tons of water over a land area of 125,000 sq. miles !

The scientific study of cyclones began more than 100 years ago. The work done during the last century gave us the essential basic knowledge necessary for issuing useful warnings about their approach. The recent growth of wireless has given the meteorologist more data from sea areas, thus enabling him to improve his forecasts and quickly disseminating the available information. The development of upper air work is gradually adding new and essential data about the changing conditions in the higher levels of the atmosphere. These are very necessary for obtaining a fuller insight into the structure and mechanism of tropical cyclones. Studies of the available upper air data in relation to cyclones are being made in a few countries, including India. The extension of scheduled flying over sea-areas makes it imperative that such studies should be intensified and accelerated. The author has not touched on this aspect of the subject, perhaps, because he feels that the data are yet insufficient.

We offer a hearty welcome to this very readable and well-produced book on what is undoubtedly one of the major phenomena of the earth's atmosphere. K. R. R.

The Observational Approach to Cosmology. By Edwin Hubble. (Clarendon Press, Oxford), 1937. Pp. 68. Price 6*s*.

It is now generally recognized that the spiral and other extra-galactic nebulæ are in reality stellar systems comparable in many respects to the system of the Milky Way of which our Sun forms a member. Herschel, by means of his star-gauges laid the foundation for the study of the structure of the galactic system and since his time, considerable progress has been made in that direction, so that the general outlines of the system have been determined with a fair amount of certainty. Very little was known about the vast number of extra galactic nebulæ until the beginning of the present century ; the nature of the nebulæ and their position in space were more or less subjects of speculation. The pioneer work of Keeler at the Lick Observatory and of Slipher at Flagstaff represent the earliest attempts towards a regular study of these extremely remote objects. Our present knowledge of the nebular system is entirely due to the large telescopes at Mount Wilson and Dr. Hubble's work with these powerful instruments forms the chief contribution to the astounding progress that has been made in the subject during the last two decades.

The present book contains the three Rhodes Memorial Lectures delivered at Oxford by the author in 1936 and summarises from the observer's point of view, the general features of the Universe as revealed by the observational data so far accumulated. The first chapter deals with the several criteria that have been developed, step by step, for estimating distances of nebulæ, ranging from the nearest to those that are at the limits of telescopic vision. An important fact established by the various surveys is the homogeneity in the distribution of the nebulæ, that extends throughout the part of the Universe under reconnaissance. Dr. Hubble considers this to be a significant factor. The region that can be surveyed is about a thousand million light years in diameter, inhabited by about a hundred million nebulæ and this observable region is taken as a fair sample of the Universe.

In the second chapter we have an account of the spectra of nebulæ and of the behaviour of the H and K lines that are found displaced towards the red. Two possible methods of interpretation of these displacements are described ; either the red shifts may be taken to be true velocity shifts due to recession or they may not be considered as velocity shifts at all, but may be attributed to some unknown physical principle. A discussion of the inferences leads to widely different pictures of the Universe according to the interpretation given to the phenomenon. The third chapter contains an exposition of the effects of the two alternative assumptions, on the surveys made in the regions of space within reach of our telescopes and their relationship to the concept of a stationary or expanding universe. Dr. Hubble concludes that, from the available data, it is not possible to affirm which of the two pictures more exactly conforms to observations.

The book gives a comprehensive account of the subject from the observational point of view. It is written in a simple lucid style and will be read with the greatest interest by all students of cosmology.

T. P. B.

The Application of Moving Axes Methods to the Geometry of Curves and Surfaces. By Dr. G. S. Mahajani. (Aryabhushan Press, Poona, India), 1937. Pp. 60.

Several geometrical results can be proved by the application of the principles of dynamics and statics. Many of these proofs are quite instructive, but the philosophical principles or foundations underlying them are those of mechanics, not of geometry. In differential geometry, the principle of moving axes is often employed to derive results. Many geometers however fight shy of this method, and prefer the purely geometrical methods. In the present pamphlet, the author applies the principle to work out several standard results and problems of elementary three-dimensional differential geometry. Dr. Mahajani commands a clear style and method of exposition. The student of differential geometry who studies the above problems through the methods advocated will, doubtless, be led into much thought-provoking study that may be of benefit to him and to the subject.

C. N. S.

Agricultural Analysis. By C. H. Wright. (Thomas Murby & Co., London), 1938. Pp. 343. Price 16*s.*

"This book is a laboratory manual giving the details of the methods of analysis of fertilizers, feeding stuffs, milk, milk-products, insecticides and fungicides with references to the sources of information.... It is intended for Agricultural Analysts with limited library facilities, etc." This book arose out of the author's personal needs when working at Fiji and Nigeria. The author has chosen to give for each subject methods recommended by the American Association of Agricultural Chemists, the British Official methods, and those in use at Rothamstead. The work would have been more complete and appeared unbiassed had he at least referred to books on Plant and Agricultural Analysis published in German and other languages. A mention of one such book *Handbuch der Pflanzen Analise* by Klein and co-workers is sufficient to show how the book can be enlarged and improved in future editions. The author has perhaps due to oversight forgotten to mention necessary details like the duration of heating, etc., in certain instances (*e.g.*, estimation of sulphur by Ailken's *method*). In the estimation of sugars he has omitted even to refer to the Polariscopic method. This is usually the method adopted by most workers in the industry.

The book has been well printed in bold type, which makes the reading all the more pleasent and easy. The binding is in a subdued sombre colour which makes it attractive. The price (16*s.*) is perhaps a little too high for the Indian student but is worth it. It can be recommended without any hesitation to those interested in agricultural analytical chemistry.

N. G. C.

The Intermediate Calculus. By Brij Mohan. (Mohan & Co., Moradabad, India), 1937. Pp. 189. Price Rs. 2-4-0.

The object of the author seems to be to make the book just meet the requirements of a certain examination syllabus. The average student, who wants to pick up the methods of differentiation and integration and apply them to simple examples, will find a helping hand in this book. He will find it elaborately worked out, for instance, that the same result is obtained whether the function $\frac{2x+3}{5x-1}$ is differentiated as a quotient or as a product or as a sum. We wish that the aim of the book was something more than this. It is late enough that text-books on the calculus, however elementary they might be, devoted some space for the definitions of convergent sequences and of continuity and explained them with striking illustrations. The author, who has, without compunction, made so free a use of infinite series to obtain limits, ought to have developed the idea of the limit of a function in a finer and more satisfactory way. One happy feature of the book is that the student is introduced to the notion of the definite integral before he is ushered into the methods of hunting after the primitives of certain functions—a feature rarely to be found in other elementary text-books.

B. S. S.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(*University Librarian, Madras*)

Buller, Walter Lawry (1838-1906)

SIR WALTER LAWRY BULLER, a New Zealand ornithologist, was born October 9, 1838, at Nowerk, Bay of Islands. He was educated at Wesley College, Auckland, where he came under the influence of William Swainson, a naturalist.

He specialised in Maori language, conducted a Maori paper, was editor-in-chief of the *Maori messenger* and held several posts connected with Maori administration. He saw active service in the Maori war and went to England (1871) as Secretary to the Agent-General for New Zealand. Having been called to the bar, he practised in the Supreme Court of New Zealand till 1886.

Amidst such a varied career, Buller had been, from an early age, a close observer of the birds of his native land, and had been fired with ambition for making himself an authority on the birds of New Zealand. When he was but thirty-four, his illustrated quarto volume *History of the birds of New Zealand* marked him out as the ornithologist *par excellence* of New Zealand. He also brought out a *Manual of the birds of New Zealand* in 1882.

He had been engaged in field observations even from his youth and the results have been recorded in about 91 papers contributed to the *Transactions* of the New Zealand Institute and a few other learned periodicals. The first paper appeared in the *Zoologist* in 1864 under the title *Notice of the remains of the moa and other birds formerly inhabiting New Zealand.* One of the last papers was, *On a species of crusted penguin from the Auckland Islands* (1899).

In recognition of his services to Natural Science, Buller was elected F.R.S. in 1879 and was decorated with an honorary D.Sc. by the Cambridge University in 1903. He was a large donor to many museums and this brought him further honours from many foreign countries.

By his persistent exploration of the recesses of his country and his continued study of its avifauna, he brought out a second edition of his *History* in 1888 enlarged into two volumes. After a further exploration for seventeen more years, Buller brought out two supplementary volumes. Till a short time before his death, he was dictating from his couch the concluding pages of the supplements "to get them off his mind".

Buller died at his daughter's residence Pontdail Lodge, Fleet, July 19, 1906.

Oliver, Samuel Pasfield (1838-1907)

SAMUEL PASFIELD OLIVER, an English geographer, was born at Bovinger, Essex, October 30, 1838. After receiving his education at Eton and Woolwich, he received a commission in the royal artillery, April 1, 1859. After seeing service in China, he spent most of his official life in Madagascar and Mauritius.

This gave him an opportunity to his geographical zeal. He spent many months in exploring Madagascar. The history, ethnology, the flora and the fauna engaged his attention. In 1864 the vulcanic eruption on the Island of Reunion gave him the opportunity to record some interesting geological phenomena as well.

In 1867 he joined Captain Pym's exploring expedition to Central America. In 1871–72 he toured in the Near East and this resulted in some first-hand archæolcgical observations in Asia Minor, Greece and Sardinia.

Oliver's varied and versatile interests prevented him from achieving eminence in any one subject. But his books on Madagascar are authoritative. They are *Madagascar and Mealagasy* (1866), *Las Hovas et les autres tribus caracteristique* (1869), *The true story of the French dispute in Madagascar* (1889) and the two volumed *Madagascar* (1886). Some of his contributions appear also in the *Report* of the British Association for the Advancement of Science and the *Proceedings* of the Ethnological Society.

Oliver's health was seriously affected by his explorations in malarial countries. He died at Worthing, July 31, 1907.

ASTRONOMICAL NOTES.

Eclipses.—There will be two eclipses in November 1938; one of these is a total eclipse of the Moon and will take place on November 8, the circumstances of the eclipse being as follows :—

Moon enters umbra	2*h*–11*m* A.M.
Middle of eclipse	3–56 A.M.
Moon leaves umbra	5–42 A.M.

The times are in Indian Standard Time. The magnitude of the eclipse is 1·36 taking the Moon's diameter as unit. The partial eclipse of the Sun that occurs on November 21–22 will not be visible in India.

Planets during November 1938.—Mercury can be seen low down in the western sky for a short while after sunset. On November 25, it will have greatest elongation from the Sun (21° 51″ E). Venus will be gradually moving westwards and during the latter half of the month, will be too close to the Sun to be conveniently visible. It will be in conjunction with Mercury on November 8 and with the Sun on November 20. Mars will be visible as a morning star, rising about three hours before sunrise.

Both the planets Jupiter and Saturn will continue to be bright objects favourably placed for observation in the early part of the night. Uranus is in the constellation Aries and can be seen near the fifth magnitude star σ Arietis. On November 8 there will be a close conjunction of the planet with the Moon, the angular distance between the two being about half a degree.

Two New Satellites of Jupiter.—Information has been received (*U.A.I. Circular* 721) of the discovery of two new satellites of Jupiter by Dr. Nicholson on photographs taken with the 100-inch telescope of the Mount Wilson Observatory. Both these satellites (tenth and eleventh in the order of discovery) are reported to be of the 19th magnitude and are extremely faint.

T. P. B.

Blyxa echinosperma.

Messrs. W. Wight and P. K. Barua, Indian Tea Association, Tocklai Experimental Station, Cinnamara, Assam, write under date, September 15, 1938, as follows :—

"We wish to draw attention to a phase in the biology of *Blyxa echinosperma* which must be familiar to field workers but which is unrecorded in any relevant literature which we have had the opportunity of consulting. The peduncles of *Blyxa echinosperma* are exceedingly long but the plant appears to inhabit water which is deeper than the maximum length of the peduncle. In deep water the roots somehow release their hold on the bottom so that the plant floats to the top prior to flowering: decay then begins amongst the floating mass of vegetation in which the flowers, with their now unnecessarily long peduncles, develop and set seed with considerable rapidity. In different tanks this phenomenon takes place at slightly different times. In shallow water *Blyxa echinosperma* seems to remain rooted, and the peduncles reach the top of the water, though appreciable decay of the submerged leaves may nevertheless take place. In deep water the rapid rise to the surface of previously submerged plants, complete with root systems, is a striking phenomenon. It would seem that *Blyxa echinsperma* is undesirable in watertanks and we have observed one case where the sudden pollution of a previously clean and sweet tank was caused by the decay of (originally submerged) *Blyxa echinosperma* plants on the surface of the water at the time of anthesis."

RESEARCH ITEMS.

Determination of Finite Groups.—An important contribution to the problem of determination of all finite groups has recently been made by Fitting (*Jahres. bericht. der deut. Math. ver.*, Bd. 48, pp. 77–141). Although the complete and satisfactory solution of the problem is still far from us this contribution makes us realise all possible groups of finite order provided the simple non-abelian groups and their group of automorphisms are known. A summary of the leading steps of his procedure is as follows:

A group is termed semi-simple if it has no normal subgroup which is soluble. If G be any finite group it follows that either it is semi-simple or it will contain a maximum possible normal subgroup N which is soluble. N is, obviously characteristically invariant (*i.e.*, for every autorphism α of G, $N^{\alpha} = N$) and G/N is semi-simple. Hence if one determines all soluble groups N_i and all semi-simple groups S_k, then every finite group can be obtained by extending some N by some S in the sense of the general theory of Schrier. The problem of determining when two such groups are isomorph is also solved here.

Next he comes to the question of determining all finite semi-simple groups. G is termed completely reducible if it is a direct product of simple groups. He shows first of all that G is semi-simple if and only if every factor in its decomposition is non-abelian. He then introduces the groups (n, G) which are formed by the n-dimensional vectors $v_{\alpha} = (\alpha_1, \alpha_3 \ldots \alpha_n)$ where α's are elements of G and (n, G) is constructed through v_{α} in such a way that $v_{\alpha} . v_{\beta} = v_{\alpha\beta} = (\alpha_1 \beta_1, \alpha_1 \beta_2 \ldots \alpha_n \beta_n)$. The first fundamental theorem is the following: If $E_1, E_2, \ldots$ are all the non-abelian finite groups, then every completely reducible semi-simple group G is constructed as the direct product

$(n_1, E_{s1}) \times (n_2, E_{s2}) \times (n_3 \times E_{s3}) \times \ldots$ where $s_1 < s_2 < s_3 \ldots$ and n_r's run through all positive integers.

He then shows that every semi-simple group G possesses a maximum possible characteristically invariant subgroup which is completely reducible, N say. He also proves the important result that $N \neq e$. It is clear therefore that G must be obtained by extending N by a suitable factor-group. The Zentralisator Z_N of N in $G = e$. Therefore it follows that every such G must be a subgroup of the group of automorphisms of N. The group A of the automorphisms of N is obviously the direct product of the group of automorphisms of its individual factors which are all simple and non-abeilan. Hence if these groups and their groups of automorphisms are known then the problem of obtaining all the semi-simple groups is solved, provided the problem of finding when two of them are isomorph is solved. It is shown by means of a procedure analogous to the proof of the known result that the group of automorphisms of a simple non-abelian group is closed, that two such groups G_1 and G_2 which are subgroups of the group of automorphisms A of the completely-reducible semi-simple group G are isomorph if and only if G_1 and G_2 are conjugate in G.

Next he deals with soluble finite groups. He proves that every such G must itself be nilpotent or it must possess a characteristically invariant maximum possible nilpotent sub-group N and $Z_N = N$. It is known that every finite nilpotent group is the direct product of its sylow sub-groups. Therefore the soluble groups G can also be obtained as the extensions of N.

He gives another method for the Schrier-extension of a group N by the factor group H which possesses a distinct advantage over the older method, *i.e.*, it enables us to find out whether two such groups G and G′ possess an isomorphy which leaves N invariant. In the extensions that are required for his purpose what is wanted is only this, as the normal subgroups considered are all characteristically invariant. The most difficult part of the whole theory consists in finding out all possible factor-systems. The article contains a good extension of Schrier's theory. In particular the problem of determining all possible p-groups is solved partially as the extension of its centre by the corresponding factor-group whose structure is assumed to be known by induction. The extensions in case where the normal subgroup has no element of the centre other than e is considerd. It is also shown as was remarked by R. Baer that the extension problem can be taken to be solved completely provided in the case when N is abelian it is completely solved. K. V. I.

A New Method of Weed Eradication.—Under the title, "Biological eradication of Kans (*Saccharum spontaneum*) in field patches" G. C. Tambe and Y. D. Wad of the Institute of Plant Industry, Indore, Central India, draw attention to what appears to be a simple and efficient method of eradicating troublesome weeds (*Agric. and Livestock in Ind.*, **8**, Part IV). The method adopted was to cover, by means of a thick mulch of green material such as sunn hemp, green grass or even green weed growth removed from fields, the patches of land overgrown with the particular weed desired to be destroyed, and allow the mulch to remain through the rainy season. At the end of this period it is found that the decomposing green material had acted on the root system of the weeds under the rotting cover green mantle and had effectively killed it. In addition to such destruction, the treated land is also said to have increased in fertility. Wheat and cotton grown on such treated plots gave significantly higher yields than the controls and in the case of wheat, the quality also greatly improved. The improvement related mainly to the total nitrogen and gluten content which were 2·07 and 11·53 per cent. respectively as against 1·65 and 8·04 per cent. in the control. The treated plots showed a higher content of organic matter in the upper zones of their soils than the

controls and it is surmised that the better quality of the wheat in the treated plots may be due to this increased organic matter content. The essential feature of the method is the use of green material as such in contradiction with dry material like straw or *bhusa* which are found to be ineffective. The method deserves to be tried in the case of other difficult weeds such as the hariali grass (*Cynodon dactylon*) of the black cotton soils, a weed which greatly reduces cotton yields and involves much cost and labour to eradicate and is seldom permanently removed even then. The touch-me-not *Mimosa pudica* is another such weed against which cultural, chemical and other methods are in practice out of the question and a suitable adaptation of this new method deserves a trial. We look forward to the author for a further study of the method on a more extended basis. A. K. Y.

The Relative Values of Organic and Inorganic Nitrogen Fertilisers.—An account of certain manurial experiments for testing the superiority of any of organic nitrogenous fertilisers over inorganic fertilisers supplying the same quantities of nitrogen conducted on the Jealot's Hill Farm of the Imperial Chemical Industries has been abstracted in the *Journal of Agriculture and Livestock in India*, 8, Part IV. The conclusions are in accordance with the opinions which used to be held until recently when organic nitrogenous manures are being credited with special virtues by reason of their content of organic matter. The experiments were conducted both on the field and in pots and cover two seasons. The crops dealt with were Brussels sprouts, mustard, barley and wheat. By organic nitrogenous manures are meant only those which supply a fairly large quantity of nitrogen entitling them to be called fertilisers and not bulky organic materials with comparatively a low nitrogen content like cattle manure. The results show that organic fertilisers are not superior to inorganic fertilisers in crop-producing power; they have no value beyond what is due to their nitrogen content. Provided the lime status of the soil is maintained at an adequate level inorganic nitrogen fertilisers will give at least as good results as organic fertilisers supplying the same amounts of nitrogen. The slow release of available nitrogen, the humus content of the manure which is held to improve the physical condition of the soil and the presence of a specific beneficial substance such as certain hormones are explained to confer no special advantages on the organic over the inorganic nitrogenous fertilisers. One feels these are far too sweeping conclusions: but even granting their correctness, it is at least doubtful if they will apply to tropical and sub-tropical conditions and furthermore over a more extended period than the two-year period over which these experiments have been carried out. A. K. Y.

Changes in the Testis of the Musk Turtle.——Very little is known about the seasonal changes in the testis of Reptiles, especially of Turtles. P. L. Risley (*Journ. Morph.*, 1938, **63**, No. 2) observes that in the musk turtle (*Sternotherus odoratus*) the spermatogenetic cycle in the testis is limited to the summer months of the year, closely paralleling that of Anura. Spermatogenesis begins in July and is completed in October. The spermatozoa are found in large numbers in the testis from September to May, in the latter month they are all expelled and the germinal epithelium prepares for the spermatogenesis. The spermatogonial divisions are most common in June.

Multiple Chromosomes of *Paratritropodia*.—The chromosomes of most Acrididæ show a remarkable uniformity in number. In males the diploid number is 23 and in females it is 24. The number in *Paratritropodia* as studied by R. L. King and H. W. Beams (*Journ. Morph.*, 1938, **63**, No. 2) is 19 in the male and 20 in the female. The reason for this decrease in number is the association of four pairs of non-homologous chromosomes to form four V-shaped multiples. These multiples result in associations of a higher order than tetrads (hexads and octads) in Metaphase I. But in *P. brunneri* the authors describe, for the first time in Acrididæ, a decad found in the 1st spermatocyte, which is formed by the accessory chromosome associated with an octad.

The Indian Central Jute Committee.*

JUTE is one of the principal cash crops of India. Though its cultivation is restricted to the Eastern Provinces, in 1936–37 it covered an area of 2·886 million acres, which produced a crop of 9·663 million bales. Assuming a price of Rs. 31 per bale, which was the average quotation of the Calcutta market on 9th March 1938, the present-day value of the jute crop raised every year in India amounts to the huge figure of Rs. 30 crores. Out of this crop over 4 million bales are exported each year in the raw state to foreign countries, a nearly equal quantity is first manufactured in the Indian Jute mills and then exported, while about 1·7 million bales of jute goods are consumed within the country.

The figures given above would give one an idea of the gigantic issues involved in the cultivation, transport, marketing, manufacture and storage of Indian jute. These issues create numerous intricate problems, some of a biological, others technical, yet others of an economic nature. Hitherto these problems have either been ignored or have been tackled in an isolated and scattered way without any systematic plan or efficient

* The Indian Central Jute Committee.—*First Annual Report*, for the period 1st December 1936–31st March 1938. Pp. 60,

collaboration between the various interests concerned in the production and manufacture of jute.

The Royal Commission on Agriculture after reviewing the situation and pointing out the defects in the existing system, or rather lack of it, recommended in 1928 the establishment of an Indian Central Jute Committee, somewhat on the lines of the Indian Central Cotton Committee, which, functioning successfully since 1920, had been mainly responsible for effecting an appreciable improvement in the quality and marketing of the Indian cotton crop. Some years elapsed before this wise recommendation of the Royal Commission on Agriculture was translated into action: the Indian Central Jute Committee was actually set up by a resolution of the Government of India dated the 28th May 1936. It has now issued its first *Annual Report* covering the period from 1st December 1936 to 31st March 1938.

This *Report*, which makes interesting reading, gives a lucid account of the manifold problems relating to the cultivation, marketing and manufacture of jute which the Committee have set before itself and the way it proposes to tackle them. On the cultivation side it has set up a small laboratory at a capital cost of Rs. 45,000 and a recurring cost of over Rs. 40,000 per annum. This laboratory situated at the Government Farm, Dacca, will study the botanical, physiological and entomological problems of jute cultivation with a view to evolving improved varieties which will be given out to the cultivators. For the supply of seed of these varieties the Committee has set aside Rs. 50,000.

For a commodity like jute, which is grown to be spun, the work in the fields and the agricultural research laboratory would remain incomplete and inconclusive if it were not supplemented by technological tests made, under standard and reproducible conditions, with the object of finding out the relative merits of the improved varieties. The Jute Committee like the Cotton Committee has recognised the supreme necessity of these technological tests and has set up a Technological Laboratory at Calcutta at a capital cost of Rs. 3,80,000 and with an estimated recurring cost of Rs. 1,80,000 for the first three years. The main function of this Laboratory, which will be equipped with a spinning mill, a conditioning plant for maintaining constant humidity and temperature in the spinning and testing rooms and a wide range of testing instruments, will be in the beginning, to test the improved varieties and to compare them among themselves and with the local varieties. Later on, when the technique of the routine tests becomes more or less established, it is expected that it will be in a position to undertake technological work on the manufacture of jute goods. When this development takes place, it is hoped that it would be possible to establish a closer *liaison*, preferably an amalgamation, with the Research Department of the Indian Jute Mills Association, as it would be undesirable and costly, in the same city, to duplicate work directed towards the same end, namely, the improvement of Indian jute and its best utilisation in the manufacturing processes.

The Committee's activities, described above, principally concern the cultivator. The Committee, however, has not wisely neglected the interests of another important class, namely, the merchants, for whose benefit it proposes to spend about Rs. 62,000 per annum on improvement of jute forecasts, Rs. 10,000 per annum on collection of statistics and dissemination of information and Rs. 30,000 on an inquiry into the marketing and transport of jute and its products.

For all these various items of expenditure the Government of India have agreed to make a yearly grant-in-aid of Rs. 5 lakhs, for five years. The work of the Committee is bound to grow, and those who are benefited by its various activities will ask for more and more problems to be undertaken by it. At the end of these five years, therefore, the Government will be faced with the necessity of either increasing the amount of the grant-in-aid or making the Committee self-supporting by levying a suitable cess on jute.

The Committee, as constituted, is a thoroughly representative body including among its members growers, merchants, spinners, administrators and experts. This feature is one of the chief sources of strength of such Committees, as the representatives of the various bodies can put forward the lines of work in which they are keenly interested and the full Committee can adopt a comprehensive view. One, however, feels that the Committee, so many of whose activities are of a scientific nature, would be strengthened by the inclusion of one or two scientists.

The success of such Committees depends to a large extent upon the first administrative officer, upon whom falls the difficult task of organising the department, laying down healthy traditions, chalking out the initial programme of work and equipping the laboratories. Judging from the manner in which the problems facing the jute industry have been analysed and set forth and the way in which the programme of future work has been drawn up, we feel that the Committee has been very fortunate in starting its career under the chairmanship of Sir Bryce Burt, who has a long and distinguished record of association with the work of such Committees and in securing the services of Mr. A. P. Cliff as its first Secretary. We feel confident that these two gentlemen will direct the Committee's activities in the right direction and we wish it a long period of useful service.

N. A.

SCIENCE NOTES.

Effect of Light Treatment on Seed Potatoes.—Mr. D. N. Sen Gupta, B.Ag., writes under date September 1, 1938:—"The beneficial effect of daylight to potatoes during the storage period has long been recognized in potato growing countries in the West. A simple experiment was carried out at Jorhat for two successive seasons of 1935 and 1936 on this line. Vernalisation of potato has been recommended by the Russian worker, Dr. Lyssenko. 120 lbs. of Darjeeling seed potatoes were used, in our experiment; one half of the quantity was stored in sand in an ordinary godown for control, and the other half was spread in a single layer and was subjected to constant illumination from close quarters under 100 c.p. light. From time to time the tubers were turned over.

In the first year electric light was used while in the second year a 100 c.p. petromax supplied the necessary illumination. The treatment continued for 28 days in each of the seasons starting on the 18th and the 27th October repsectively. The observed difference in the general vigour of the standing crops under the two treatments fairly agreed with the actual finding at harvest. The first year's crop, vernalized under the electric light, gave the best result while the second year's crop vernalized by the petromax did not respond so well.

The results of two years' work have definitely shown that exposing potatoes to light continually for 25–28 days gives about 50% more yield although the cost of such a treatment is negligibly small in comparison to the yield obtained."

* * *

Ancient Culture in the Indus Valley.—Discoveries throwing new light on the problem of the successive cultures that flourished in the Indus Valley in the 3rd millennium B.C. have been made. Overlying the main cultural stratum contemporaneous with Mohenjodaro, there have been found two later ones, which appear to belong to a people unconnected with the earlier civilization.

This interesting information is given in the latest *Annual Report* of the Archæological Survey of India for the year 1935–36, which records the arrival during the year of the expedition of the American School of Iranian and Indic Studies. Dr. E. J. H. Mackay, formerly of the Archæological Survey, was the Field Director of the expedition.

Chanhu-daro in the Nawabshah District of Sind was the site selected for excavation by the expedition. That during the Mohenjodaro period Chanhu-daro was an important industrial town, specializing in the manufacture of beads and toys, is one of the conclusions reached as a result of the excavations made. Discoveries have also been made, which show not merely what the finished articles were, but also the successive stages of making beads out of fresh agate nodules.

The departmental programme of excavation was fairly well spread over Northern India within the limited funds available. In Sind two sites in the Khairpur State, *viz.*, Dijijitakri and Kotasur, have been explored. The 40 feet high mound at the former place has revealed five strata illustrating the earlier and later stages of the Indus Valley culture, and also at Kotasur, pottery of late prehistoric period with interesting painted designs, both geometrical and animal, has been brought to light.

At Taxila, the north-west portion of the monastery attached to the Dharamarajika stupa, was exposed, completing the lay-out of the monastic complex. A hoard has been found of 500 coins, mostly of Vasudeva, the Kushan king, which fixes the date of the monastery as the 3rd century A.D. Images of some Brahmanical deities, such as Vishnu and Kartikeya, have also been found at the place. The find of these Brahmanical images, in the Buddhist establishments of Taxila before their destruction at the hands of the Hun hordes, it is said, exemplifies once more the eclectic tendency of the Gupta Empire.

Fresh excavations in Bihar have brought to light two more monasteries at Nalanda, and some interesting early relics of Naga worship at the Maniyar Math at Rajgir. At Lauriya Nandangarh, in the district of Champaran, excavations were conducted in several mounds with a view to examine the character of the remains. These remains, according to conclusions reached, appear to be of several Buddhist stupas, some of which date back to as early as the 4th century B.C. At Nandangarh, in a mound 82 feet high. discovery has been made of a basement wall of a colossal structure with a number of re-entrant angles.

In Bengal an interesting monument consisting of 170 chambers of shafts, which present a curious honey-combed appearance, has been unearthed at the Medh mound near Gokul in the Bhogra District. The monuments here are nearly 1300 years old, being of the 6th or 7th century A.D. and, according to archæologists, appear to have been within the suburbs of the city of Mahasthan.

Other discoveries made during the year include a number of sites consisting of burial chambers in rock or pottery vases and urns in Malabar. Tinnevelly, Coimbatore, North Arcot and Cuddappah Districts in Madras, and an old brick monastery, close to the Somingyi pagoda at Myinpagan in Burma.

In Jaipur a unique circular Buddhist temple of the 3rd century B.C. and a large monastery, which continued to be occupied up to the 1st century A.D. have been brought to light by the local Director of Archæological Survey.

The most important discovery of the year in epigraphy, it is said, is that of four-stone pillars at Badva, in the Kotah State of Rajputana, recording the performance of a sacrifice by three sons of a Mokhari General all dated in 295 Vikrama era, equivalent to 238 A.D.

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With the object of finding out additional outlets for Indian short staple cottons, the **Indian Central Cotton Committee** has set aside a sum of Rs. 30,000 to explore the possibilities of manufacturing rayon from short staple cotton, particularly from cotton linters and similar materials. The Industrial Research Bureau is collaborating

with the Committee in these enquiries and in working out the relative costs and the suitability of the various processes for the manufacture of artificial silk in India. The data so far available indicate that the price of chemical cotton manufactured from short staple cotton would be far too high, but there is a possibility that chemical cotton produced from linters would be reasonably cheap. It is now proposed to carry the experimental work done in the past for the determination of the cost of producing chemical cotton, a stage further by the installation of a small-scale pilot plant for determining the cost of preparing chemical cotton which is the basis for rayon manufacture.

* * *

The Periodical 'Failures' of Cotton Crops in the Punjab.—Through the kind courtesy of the Secretary, Indian Central Cotton Committee, we have received certain extracts from Dr. Mason's inspection report on the scheme of periodical 'failure' of cotton crops in the Punjab. The Punjab American Cotton Industry is still young. It was not till 1905, that American seed was imported from Darwa and selection begun. All the major crop 'failures' occurred between 1919-1928. There has been no major 'failure' since, though 'partial failures' occurred in 1931 and 1932. Similar 'failures' occur in Sudan and the cause of the Sudan 'failure' is not yet known.

The Punjab American Cotton Industry, appears to be approaching a condition of equilibrium. There are two reasons for this; the plants get acclimatised the longer they are cultivated and the grower learns by experience the cultural requirements of the crop.

From an examination of all relevant facts relating to the 'failures' Dr. Mason considers it probable that the 'failures' occurred as a result of interaction of at least two factors: "We may postulate first of all a soil factor, probably high content of alkali salts, which may persist for more than a single year. In the presence of this factor any climatic or insect (*e.g.*, white fly) factor detrimental to growth may result in crop 'failure'. It is noteworthy that the 'failure' years appear to have been years of high July-August rainfall, but that high rainfall at this time of year has not always been accompanied by a 'failure'. The Sandwiching of 'partial failures' between 'full failures' may be explained by assuming that the climatic factors have been relatively favourable for growth, even though the alkali content of the soil may have been high. It will be clear that soil alkali may adversely affect the activity of the nitrogen bacteria.

"To sum up it is suggested that periods of 2–3 years have occurred during which the salt content of the soil has remained high and that this has rendered the plant susceptible both to Tirak and to nutritional bad opening of the boll. It is further suggested that when a year in which the climate is detrimental to growth has synchronised with one of these periods of high soil salt content, a 'failure' has occurred. It is not improbable that in the past there has been some confusion between Tirak and nutritional bad opening."

* * *

Flying Training in India.—The introduction of the Empire Air Mail Scheme, the provision of night flying facilities and the grant of large subsidies to the flying clubs by the Government of India have resulted in a substantial increase in the number of hours flown and the number of 'A' pilots trained.

The three-year agreement which the Government of India has with the subsidised flying clubs, expires at the end of the current year.

The total amount of the subsidy grant distributed among the seven clubs was Rs. 1,43,128 in 1936–37, and Rs. 1,36,500 in 1937–38. The increased flying done by the clubs has been devoted principally to the training of commercial pilots, although the clubs do not earn Government bonuses in respect of such training.

The number of commercial pilots trained for the past 3 years, 1935, 1936 and 1937, are respectively 9, 18 and 20.

Introduction of the Empire Air Mail Scheme early in 1938, has been responsible for a substantial increase in the number of persons actively employed in civil flying in India. The total number employed by the aircraft operating companies operating wholly in India, was 115 as on 31-12-1936 and 269 as on 31-7-1938.

One of the difficulties with which the operating companies were faced was in providing the advanced training which is necessary before a pilot, who has been wholly trained on the light types of aircraft such as are owned by the flying clubs, can be given charge of a larger type of commercial machine which has a higher performance. The Government of India gave assistance by arranging special flying courses on their Avro-X aeroplanes, and Tatas established, at their own cost, in addition what virtually amounted to an advanced flying training school. They also undertook the further training of wireless operators, whom they recruited from those candidates who had passed the wireless course at the *Aeronautical Training Centre of India*.

While the flying clubs provide the necessary regional centres for initial training, the need has been felt for an advanced aviation school.

If there is not to be retrogression, it would seem that the flying clubs in India will have to be given a fresh *raison d'etre* as well as a new subsidy agreement at the end of the year.

* * *

Deterioration of Structures in Sea-Water.—A Committee of the Institution of Civil Engineers has been studying the problem of the deterioration and protection of structures in sea-water since 1916. Reports have been issued at approximately yearly intervals, the recent Report (H. M. Stationery Office, London, 1938) being the 17th of the series. Reports are given on the condition of timber specimens subjected to protective treatment and exposed to sea-action in various parts of the world. Results are given of a research into the deterioration of reinforced concrete. The present report is of particular interest in that it contains the complete sets of figures for the corrosion of iron and steel bars exposed in various Ports for periods of 5, 10 and 15 years, this research being now concluded.

On August 2nd, **Jean Baptiste Perrin** one of the leading physicists of the world, announced to the *French Academy of Sciences*, the discovery by his collaborators of what he believed to be the ninety-third chemical element. Perrin, who is President of the Academy, reported that the new substance is heavier than uranium, which up to this time has been known as the heaviest of all substances. Many physicists have limited the number of possible elements to ninety-two on the assumption that any substance heavier than uranium would not be stable enough to hold together. Perrin, however, announces that his new discovery would be in natural and stable form, and could be produced in definite quantities (*Sky*, 1938, **2**, No. 11, 13).

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University of Bombay.—

Dr. K. Venkataraman, D.Sc., Ph.D. (Manchester), F.I.C., has been appointed Mody Professor and Head of the Department of Chemical Technology in the University of Bombay to succeed Professor R. B. Forster, D.Sc. (N.U.I.), Ph.D. (Berlin), F.I.C.

Dr. T. S. Wheeler, Principal, has been granted leave preparatory to retirement. He will sail for England on the 22nd inst. to join next year the post of State Chemist to the Government of Eire.

Presiding over the students' function in honour of Dr. Wheeler, Mr. V. N. Chandavarkar, the Vice-Chancellor, paid tribute to Dr. Wheeler for his work in the University and in the Institute for the cause of science. He referred to him as an administrator known for his strict discipline and impartial decisions.

The University of Bombay has conferred the Degree of Doctor of Science on Mr. N. C. Chatterji, Entomologist, Forest Research Institute, Dehra Dun.

* * *

Calcutta University.—The degree of Doctor of Science has been awarded to **Mr. Ranjit Ghose, M.Sc.,** in consideration of his thesis dealing with (1) the synthesis of Jaborandi Alkaloids, (2) studies in phenanthrene and (3) a new synthesis of carmic acids.

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We have pleasure in announcing that **Dr. M. B. Mirza, D.Sc.,** Director, Zoological Laboratories, Muslim University, Aligarh, has accepted our invitation to join the Board of Editorial Co-operation.

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Announcements.

Indian Academy of Sciences.—It has been decided to hold the *Fourth Annual Meeting of the Academy*, at Madras, between the 19th and 24th December 1938. The exact date or dates of the meeting will be communicated to Fellows in due course.

Papers intended for presentation at the Scientific Meeting during the annual session may kindly be sent in to the Secretary, Indian Academy of Sciences, Hebbal P.O., Bangalore, at an early date.

The Entomological Society of India.—The first annual general meeting of the Entomological Society of India will be held in Lahore in the first week of January 1939. Intimation of the exact date, time and place of the meeting will be communicated to members later. In the meantime the following may be sent to the Secretary at the Imperial Agricultural Research Institute, New Delhi, by the end of October 1938 :—

(i) Abstracts of papers which any member may desire to read and also an indication of the nature of the exhibit to be shown and a very short summary of the remarks to be made thereon.

(ii) Proposals, if any, for the amendment of the existing rules of the Society, a copy of which may be obtained from the Secretary.

(iii) Notice of any discussion that any member may propose to initiate relating to the scientific or non-scientific business of the Society.

Only members who have at least paid their admission fee to the Society in the year 1938, will be eligible to vote and take part in the non-scientific business of the Society.

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We acknowledge with thanks, receipt of the following :—

" Agricultural Gazette of New South Wales, " Vol. 49, No. 9.

" Journal of Agricultural Research, " Vol. 56, Nos. 2 and 3.

" Indian Journal of Agricultural Science, " Vol. 8, No. 4.

" Monthly Bulletin of Agricultural Science and Practice, " Vol. 29, No. 8.

" The Philippine Agriculturist, " Vol. 27, No. 4.

" Allahabad Farmer, " Vol. 12, No. 4.

" Journal of the Royal Society of Arts, " Vol. 86, Nos. 4475–78.

" Biochemical Journal, " Vol. 32, No. 8.

" Journal of the Indian Botanical Society, " Vol. 27, No. 4.

" Journal of the Institute of Brewing," Vol. 44, No. 8.

" Chemical Age, " Vol. 39, Nos. 1000–1003.

" Journal of Chemical Physics, " Vol. 6, No. 9.

" Journal of the Indian Chemical Society, " Vol. 15, Nos. 7 and 8.

" Berichte der Deutschen chemischen gesselschaft, " Vol. 71, Nos. 8–9.

" Journal de chemie physique, " Vol. 35, No. 7.

" Transactions of the Faraday Society, " Vol. 34, No. 209.

" Indian Forester, " Vol. 44, No. 10.

" Indian Forest Records, " Vol. 3, No. 3.

" Forschungen und Fortschritte, " Vol. 14, Nos. 25–27.

" Genetics, " Vol. 23, No. 5.

" Journal of the Mining and Metallurgical Institute of India, " Vol. 34, No. 2.

" Bulletin of the American Meteorological Society, " Vol. 19, No. 6.

" Journal of the Indian Mathematical Society ", Vol. 3, No. 3.

Catalogues.

Messrs. Cambridge University Press, London, " Autumn Books ".

Messrs. Edward Arnold & Co., New Books, Autumn 1938.

ACADEMIES AND SOCIETIES.

Indian Academy of Sciences:

September 1938. SECTION A.—(MISS) IONE NITRAVATI DHARAM DASS AND SIKHIBHUSHAN DUTT: *Colour in Relation to Chemical Constitution of the Organic and Inorganic Salts of Iso-nitro-diphenyl-thio-Barbituric Acid and its Higher Homologues and Analogues.*—The orange coloured acid, on treatment with alkalis or organic bases, changes into intense blue and green coloured salts. This is shown to be due to a fundamental change in the constitution of the molecule from an oximino-ketonic to a nitroso-enolic structure. INDER CHOWLA: *A Theorem in the Additive Theory of Numbers.* R. VAIDYANATHASWAMY: *Quasi-boolean Algebras and Many Valued Logics.* V. D. MAJUMDAR AND M. B. VAJIFDAR: *Coefficient of Viscosity of Air.*—Using a modified form of Wagstaff's apparatus for measuring by the method of interference fringes, η_{23}°C has been determined as $(1834 \cdot 38 \pm 0 \cdot 35) \times 10^{-7}$ *c.g.s.* units. A. NARASINGA RAO: *Studies in Turbine Geometry.—II. On the Sub-Geometries of Lie which belong to the Mobius-Laguerre Pencil.*

September 1938. SECTION B.—M. S. RANDHAWA: *Observations on Some Zygnemales from Northern India—Part I.* G. N. RANGASWAMI AYYANGAR, V. PANDURANGA RAO AND D. S. RAJABHOOSHANAM: *Sorghum-Size Relationships of Seed Embryo, Seedling and the First Seedling Leaves.* C. BHASHYAKARLA RAO: *The Myxophyceæ of the Orissa Province, India—I.* A. RAMAKRISHNA REDDY: *The Cytology of Digestion and Absorption in the Crab* Paratelphusa (Oziotelphusa) hydrodromus (*Herbst*). L. P. MATHUR AND MUNSHI LAL SHARMA: *Observations on the Abnormalities in the Common Indian Frog,* Rana tigrina *Daud.* JAI CHAND LUTHRA, ABDUS SATTAR AND SARDUL SINGH: *Occurrence of Stem Canker Disease of Sugarcane* (Cytospora sacchari *Butyl*). *in the Punjab.* P. N. MEHRA: *Apogamy in* Adiantum lunulatum *Burm., Part I. (Morphological).* P. N. MEHRA: *Apogamy in* Pteris biaurita *Linn.* P. N. MEHRA: *Some Abnormalities in the Female Strobilus of* Ginkgo biloba *L.* P. N. MEHRA: *The Germination of Pollen Grains in Artificial Cultures in* Ephedra foliata *Boiss and* Ephedra gerardiana *Wall.* B. L. BHATIA AND S. B. SETNA: *On Some Gregarine Parasites from Certian Polychete Worms from the Andaman Islands.* V. RANGANATHAN AND B. N. SASTRI: *Procedure for Determining the Nature of the Degradation Products during Proteolysis.*

National Academy of Sciences:

June 1938.—SATYA PRAKASH AND SIKHIBHUSHAN DUTT: *Colour and Chemical Constitution. The Organic and Inorganic Salts of Diphenylvioluric Acid.* V. S. DUBEY, Y. P. VARSHNEY AND R. S. SHARMA: *Caustic Soda and Alumina from Salt and Bauxite.* MAHADEO PRASAD GUPTA AND SHIKHIBHUSHAN DUTT: *Chemical Examination of* Indigofera linifolia *Retz. The Isolation of its Active Principle.* J. DAYAL: *Studies on the Trematode Parasites of Fishes.—A New Trematode* Nixamia hyderabadi *N. Gen., N. Sp., from the Intestine of a freshwater fish,* Ophiocephalus punctatus.

August 25, 1938.—SHAH MUHAMMAD SULAIMAN: *The Mathematical Theory of a New Relativity (Generalised Gravitation).* A. C. BANERJI AND P. L. BHATNAGAR: *The Solution of Certain Types of Differential Equations.* R. D. VIDYARTHI: *New Avian Trematodes (Family Diplostomidæ) from Indian Birds.* GAURI SHANKAR BASU AND S. B. DUTT: *Tungsten and Molybdenum Powder in Organic Synthesis.* S. B. DUTT: *Chemical Examination of Indian Molasses: Fusel Oil from the Patent Still Distillery of Messrs. Carew & Co., at Rosa, Shahjehanpur.* ANIL CHANDRA CHATTERJI AND SHIKHIBHUSHAN DUTT: *Cadmium Powder as a Synthetic Reagent.* BINAYENDRA NATH SEN: *The Formation of Liesegang Rings in the Presence of Precipitates.* R. C. CHATTERJI: *Annotated List of the Helminths recorded from Domesticated Animals of Burma, Part I. Trematoda.* B. N. SINGH AND M. L. MEHTA: *Changes in Respiration and H-ion Concentration in Wounded Potato Tubers.*

Indian Association for the Cultivation of Science: (*Proceedings, Volume 21, Part IV.*)

August 1938.—JAGANNATH GUPTA: *Hexa-co-ordination in Telluric Acid and in Molybdates and Tungstates in Solution.* BIBHA MAJUMDAR: *The Theory of Absorption in Ionised Gas. I. Opacity in Stellar Material. II. Optical Properties of liquid metals.* K. BANERJEE AND RAJIUDDIN AHMED: *Structure of Aromatic Compounds. Part IV. Space Group and Atomic Arrangements in Phloroglucine Dihydrate.* KRISHNAPADA GHOSH AND BONBEHARI GHOSH: *On the Electric Conduction due to 4 Electrons in some Trivalent Rare Earth Compounds.* S. K. MUKERJI AND ABDUL AZIZ: *On the Raman Spectrum of Diphenyl.* G. R. PARANJPE AND D. J. DAVAR: *Dielectric Properties of Some Organic Substances.* S. R. KHASTGIR AND M. K. CHAKRAVARTY: *The Attenuation of Ultra-Short Radio Waves along with Earth.*

Indian Physical Society:

August 27, 1938.—MRS. B. MAJUMDAR: *Theory of Absorption in Ionised Gases—Part II. Optical Properties of Liquid Metals.* P. KOTESWARAM: *Dissociation in Sulphuric Acid with Temperature.* K. BANERJI AND R. AHMED: *Structure of Aromatic compounds. IV. Space Groups and Atomic Arrangements in Phloro-glucine Dihydrate.* P. GHOSH AND B. B. GHOSH: *On the Electronic Conduction due to '4 f' Electrons in Some Trivalent Rare Earth compounds.* S. BASU AND A. T. MAITRA: *Thermal Coefficient of Rock-Salt by X-ray Reflection.*

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Indian Chemical Society:

July 1938.—PRIYADARANJAN RAY AND NRIPENDRA NATH GHOSH: *Complex Compounds of Biguanide with Tervalent Metals. Part II. Chromium Biguanidines.* PRIYADARANJAN RAY AND NRIPENDRA NATH GHOSH: *Complex Compounds*

of Biguanide with Tervalent Metals. Part III. Chromium Phenylbiguanidines. PRIYADARANJAN RAY AND HARIBOLA SAHA : *Complex Compounds of Biguanide with Tervalent Metals. Part IV. Chromium* bis-*Biguanidines.* SISIR KUMAR GUHA : *Studies in Indigoid Dyes. Part III.* MATA PRASAD, S. M. MEHTA AND MISS H. RATHNAMMA : *Studies in Thixotropic Gelation of Thorium Molybdate gels.* SHRIDHAR SARVOTTAM JOSHI AND T. V. SUBBA RAO : *Electrodeposition of Lead on Base Metals. Part I. Behaviour of Alkaline Baths with Iron Cathodes at Low Current Densities.* S. M. SETHNA AND R. C. SHAH : *Pechmann Condensation of Methyl β-Resorcylate with Ethyl α-Alkylacetoacetates.* M. K. MADHURANATH AND B. L. MANJUNATH : *Chemical Examination of the Oil from the Seeds of* Santalum album (*Linn.*). KARTAR S. NARANG, JNANENDRA NATH RAY AND BHARPUR SINGH ROY : *Rottlerin, Part II.* S. CHATTERJEE, M. SANYAL AND M. GOSWAMI : *Studies in Catalytic Dehydration.* MAHAN SINGH : *Dimethylamino and Diethylaminophenyliminocamphors. Reagents for Mercury.*

August 1938.—K. GANAPATHI : *The Chemistry of Some Derivatives of Decalin, Part I.* BALWANT SINGH AND G. AHMAD : *Potentiometric Studies in Diazotisation. Determination of Aromatic Amides.* MR. RAMART, K. G. NAIK AND C. M. MEHTA : *Relation between Chemical Activity and Absorption in the Ultra-Violet of Certain Organic Molecules : Part I.—Study of the Absorption Spectra of the Chloro Derivatives of the Substituted Amides of Malonic Acid.* K. G. NAIK, R. K. TRIVEDI AND C. M. MEHTA : *Relations between Chemical Activity and Absorption in the Ultra-Violet of Certain Organic Molecules : Part II. Velocity of Saponification of the Chloro Derivatives of the Substituted Amides of Malonic Acid.* S. CHATTERJEE, A. SHAH AND M. GOSWAMI : *Composition of Boiled Oil.* BAIDYANATH GHOSH AND B. C. GUHA : *Vitamin C and Toxins : Part I—The Effect of Vitamin C and other Reducing Substances on Diphtheria and Tetanus Toxins* in vitro. BAIDYANATH GHOSH AND B. C. GUHA : *Vitamin C and Toxins : Part II.—The Effect of the Administration of Vitamin C to Guinea-pigs Injected with Diphtheria and Tetanus Toxins.* BAIDYANATH GHOSH : *Observations on the Relation between Pregnancy, Sex-harmones and the Vitamin C Content of the Tissues of Guinea-pigs.* S. K. MITRA : *Experiments on the Synthesis of Cytisine : Part I. Synthesis of 3 : 5 Dicarbethoxypyrone-6-acetate and the corresponding Pyridones.* MUHAMMAD QUDRAT-i-KHUDA, ASHUTOSH MUKHERJI AND PHANIBHUSHAN BANERJI (in part) : *Strainless Monocyclic Rings. Part II.—Synthesis of 3-Methyl-cyclohexane-1-carboxyl-1-acetic acid and Sepration of its Isomers.* G. P. PENDSE AND JAGRAJ BEHARI LAL : *Constitutents of the Seeds of* Blepharis edulis *Pers. The Composition of the Oil. A Correction Note.*

Indian Botanical Society:

September 1938.—BOERGESEN, F. : *Contributions to a South Indian Marine Algal Flora—III.* KAJALE, L. B. : *Embryo and Seed Development in the Nyctaginaceæ.—I. Studies in the Genus* Boehaavia. DASTUR, R. H., AND WINIFRED JOHN: *The Growth of Rice Seedlings in Salt Solutions of Different H-ion Concentrations.* SCHMID, E. : *Contributions to the Knowledge of Flora and Vegetation in the Central Himalayas.*

The Entomological Society of India:

(*New Delhi Branch.*)

July 26, 1938.—E. S. NARAYANAN : *Biology of Two Indian Species of* Apanteles (*Braconidiæ*) *of Economic Importance.* L. N. NIGAM : *Life-History of the* ak *Grasshopper*, Pœcilocerus pictus.

The following exhibits were shown and commented upon : Three species of termites swarming in Delhi early in the rainy season (H. S. Pruthi) ; *Myllocerus* Prox *lactivirens* Marshall, damaging cotton at Delhi ; *Anomala lineatipennis* damaging apple fruits in Simla ; Egg clusters, pupæ and adults of *Epistictia viridimaculata* Boh. from leaves of *Steriospermum suaveolens* in Dehra Dun and grubs of *Podontia* 14-*punctata* (?) infesting *Dualianga sonnertoides* in Dehra Dun (T. Ahmad) ; A nest of the red-ant, *Oecophylla smaragdina* F., from Karnal (Ghulam Ullah) ; *Chilomenes sexmaculata* F. (Coccinellidæ) showing colour variations (A. P. Kapur) ; Nest of the spider *Stegodyphus sarasinorum* Karsch, and some of its fauna from Dehra Dun (K. B. Lal).

A resolution deeply regretting the death of Dr. Geza de Horvath of Budapest, one of the founders of the modern classification of Hemiptera, was passed unanimously.

Meteorological Office Colloquium, Poona:

August 31, 1938.—RAO BAHADUR Y. RAMACHANDRA RAO, Locust Research Entomologist, Karachi, on "*The Locust Problem in India*".

SUPPLEMENT TO "CURRENT SCIENCE".

Vol. VII] October 1938 [No. 4

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Cambridge, 1938.

Summaries of Addresses of Presidents of Sections.

MATHEMATICAL AND PHYSICAL SCIENCES.

President: Dr. C. G. DARWIN, F.R.S.

LOGIC AND PROBABILITY IN PHYSICS.

RECENT scientific history has revealed a deep schism between the professional philosophers and the scientists, and this schism is worthy of examination. Prof. Darwin, therefore, deals with the wide theme of the philosophy of physics.

Prof. Darwin develops the idea that the old logic was devised for a world that was thought to have hard outlines and that, now that the new mechanics has shown that the outlines are not hard, the method of reasoning must be changed. The key to this is the principle of probability, but whereas in the past, attempts were made to fit this into the old system, the new mechanics suggests the possibility of a different synthesis.

The really live branches of physics call for a very different kind of thought from the old formal logic; in fact, outside pure mathematics any subject is apt to become dead and uninteresting as soon as it is brought down to this form. Axioms are not really the most important things, but it is the whole body of accumulated doctrine that matters. Also the idea of a " crucial " experiment believed in by the ' logic ' school has not much force, since it is the cumulation of a number of pieces of evidence and not one of the pieces that makes us believe in a physical theory—for example, relativity. An axiomatic basis is too narrow for the understanding of the physical world.

Something wider is needed, a wider system of logic which has probability for one of its features, but there does not seem to be much use in trying to bring probability into the narrow fold of the old logic. A review of recent history of atomic theory has shown clearly that the prejudice against probability and in favour of causality is wrong for a reason never previously thought of. This theory revealed two mutually contradictory but both indubitable pieces of evidence, and in the dynamic period of its development, Bohr and other leaders recognised the difficulties on both sides but maintained an attitude of balance hoping for the coming of a higher synthesis. Quantum theory grew stronger and stronger, and finally the New Quantum Theory burst forth placing in the hands of the mathematicians the wave function, the most powerful of weapons for the technical discussion of atomic problems. It was however the Uncertainty Principle that showed up a fallacy in the old argument about causality. It is now easy to see that there was nothing wrong in the old inference that the future could be forecasted exactly if we know all about the present; but the trouble was the impossibility of knowing the present.

One of the most convincing ways of seeing that probability cannot be brought within the fold of formal logic is the kinetic theory of gases. The greatest contribution to this subject was that of Gibbs who introduced the notion of ensemble, and canonical ensembles. The principle of probability embodied in the averaging over the ensemble was frankly laid on the top of the logical principles of Newtonian mechanics, but it is now found that the new mechanics accommodates it much more easily and can be united with it in a higher synthesis. Another idea developed in Gibbs' work, that of the grand ensemble has not yet been incorporated in the new physics, and one may venture to forecast that when some of our present difficulties in the quantum theory are cleared up, it will be found that we shall be using the notion of the grand ensemble. A real and full synthesis is still to be made and when this is made we may hope to have something that has no indefinite outlines, *i.e.*, a new and reformed principle of reasoning.

The subject of probability ought to play an enormously greater part in our mathematical-physical education, and its elements should form part of a general education also. Mathematicians are still so interested in the study of rigorous proof that all the emphasis goes against the study of probability. It may however be said that it is not special new courses that are needed, but rather a change in the spirit of our old courses, by the incorporation of probability in other subjects,

If these reforms are carried out, it may be hoped generations will grow up which have a facility in thinking about the world in the way which quantum theory has shown to be the true one. Inaccuracy in the world will not be associated with inaccuracy of thought and the result will ultimately be a fuller and better understanding of the basis of natural philosophy.

B. S. MADHAVA RAO.

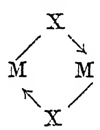
CHEMISTRY.

President: PROF. CHARLES S. GIBSON, O.B.E., M.A., Sc.D., F.R.S.

RECENT INVESTIGATIONS IN THE CHEMISTRY OF GOLD.

THE address commences with a discussion of the evidence concerning the multivalency of copper, silver and gold, by a study of some of their important compounds. It is pointed out that the univalency and bivalency of copper and silver are well established and that the tervalency of silver is still a doubtful matter. Modern investigations have shown that gold differs from copper and silver in that it exists only in the univalent and tervalent conditions and that it is extremely unlikely that it ever exists in the bivalent condition.

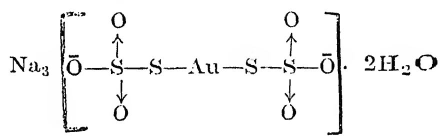
Recently, chemical evidence has indicated that cuprous halides, silver halides and aurous halides have the general formula:



where X = halogen, indicating the 2-covalency of cuprous copper, argentous silver and aurous gold in these compounds.

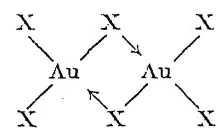
Bassett and Corbet (1924) proved by a phase-rule study of the complex cyanides of copper, silver and gold that cuprous copper and argentous silver can exhibit 2- and 4-covalency wheras aurous gold showed a co-ordination number of only 2. Mann, Wells and Purdie also (1936 and 1937) came to the same conclusion after a study of the trialkylphosphine and trialkylarsine derivatives of cuprous, silver and aurous halides.

" Much of the confusion of knowledge regarding the chemistry of gold as described in almost all text-books and more comprehensive works arises from the fact that the simple halide and cyanogen derivatives are regarded as normal metallic salts and given the formulæ AuCl, AuBr, AuI, AuCN, $AuCl_3$, $AuBr_3$ according to the fundamental uni- or tervalency of the metal. This is all the more surprising in view of the long-established and well-known fact that whenever gold is in solution or in the form of a soluble salt it is always present as a complex. There is only need to mention as examples potassium aurocyanide, probably—on account of its application in the metallurgy of gold—the most completely investigated derivative of the metal and the very interesting sodium aurothiosulphate prepared as long ago as 1845 by Fordos and Gelis. Even at the time of its discovery, this latter compound was known to give neither the usual reactions for gold nor the usual reactions of a thiosulphate. It has long been used for fixing and toning silver photographic prints. Since its introduction in 1924 by the Danish physician, Möllgaard, for the treatment of tuberculosis and, later by others for the treatment of rheumatoid arthritis, it has been considerably investigated and has formed the basis of the modern ' gold therapy '. Curiously enough, in a standard text-book published as recently as 1937, the formula, $Au_2S_2O_3 . 3 Na_2S_2O_3 . xH_2O$ seems to be preferred to the correct $Na_3 Au(S_2O_3)_2$ 2 H_2O which may be fully written



in which, of course, the aurous gold atom is 2-covalent, the compound being of the same type as the well-known potassium aurocyanide, K [N ≡ C – Au – C ≡ N], already mentioned."

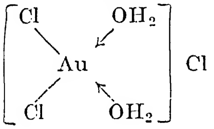
The best known auric compounds are the halogenoaurates. Some of the recently investigated compounds of this type are hydronitratoauric acid, hydrodisuccinimidochloroauric acid, hydrodiphthalimidohydroxyauric acid, and hydrodimethylglyoximinylbromoauric acid. All the above compounds contain the 4-covalent auric gold atom. Auric chloride (trichlorogold) or auric bromide can be adequately represented by the formula:



(X = Cl, Br)

Professor Gibson justifies his suggestion for a modified nomenclature of certain gold compounds as follows: " My suggestion for a modified nomenclature of certain gold compounds may be criticised as being, if not pedantic, unnecessary. It arises from obvious analogies of the organic compounds of gold with similarly constituted inorganic compounds of the metal; its only object is to avoid further confusion in the chemistry of gold. Such confusion is constantly occurring. At the present time, in books of reference and even in original literature ' auric chloride ' may imply hydrochloroauric acid in the presence or absence of hydrochloric acid, or it may imply a neutral salt—generally the sodium salt—of hydrochloroauric acid and, much less frequently gold trichloride or—to alter its name more profoundly in order to indicate that the compound is not a salt—trichlorogold. As a result of this confusion the statement is repeatedly found in the literature that ' auric chloride is soluble in ether '. If this statement refers to the pure compound having the molecular formula $(AuCl_3)_2$, it is not true. Hydrochloroauric acid and hydrobromoauric acid containing water of crystallisation, the compounds $HAuX_4 . 3 H_2O$, are soluble in ether but they are insoluble when anhydrous. Although the fact

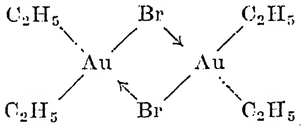
was known long before, the definite statement that gold chloride is soluble in ether appears to be due to Willstätter (1905); but it is clear that the material he was investigating was not $(AuCl_3)_2$, but an aqueous solution of hydrochloroauric acid which he termed gold chloride; and, as a result, the above erroneous statement is still in text-books published as recently as 1937. The hygroscopic nature and solubility of 'auric chloride', *i.e.*, gold trichloride, in water is not due to the solubility of the compound *per se*, but to the formation in the first place of a compound diaquodichloroauric chloride,



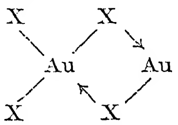
a type of co-ordinated auric gold salt, frequently met with in the present series of investigations, which is soluble in water and undergoes further changes in that medium resulting in the formation of hydrochloroauric acid and aurous chloride (monochlorogold).

The following is a short account of the researches on the chemistry of gold carried out by Prof. Gibson and his collaborators:

(*a*) *Dialkyl halogeno compounds* (Pope and Gibson, 1907; Gibson and Simonsen, 1930, and Gibson and Colles, 1931). Gibson and Pope prepared in 1907 the first organic gold compound then styled diethylauric bromide. This work was greatly extended by the work of Gibson and Simonsen (1930) and Gibson and Colles (1931). The typical compound of this series diethylmonobromogold has the formula:

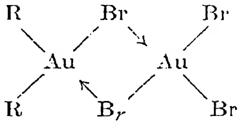


The other compounds prepared include amminodiethylbromogold, pyridinodiethylbromogold, and dibenzylsulphidodiethylbromogold. Acetylacetonediethylgold was the first organic gold compound containing no halogen to be prepared and from which brilliant gold films could be obtained. Derivatives containing ethylenediamine similar to the above-mentioned ammino and pyridino derivatives were also obtained and one of the monoethylenediaminotetra-*n*-propyldibromodigold (Burawoy and Gibson, 1934) was found to yield the salt ethylenediaminodi-*n*-propylgold bromide. Decomposition of such compounds in which two 4-covalent auric gold atoms were present in the molecule resulted in a mixed auric-aurous compound in which the gold atoms were 4-covalent and 2-covalent respectively. This suggests that such halides as Au_2X_4 (formerly written as AuX_2) would be mixed auric and aurous compounds as



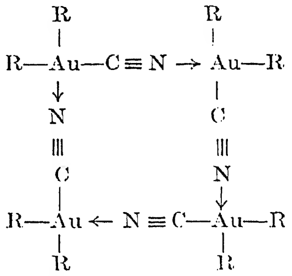
and that they might be formed as intermediate products in the decomposition of the trihalides to the monohalides.

(*b*) *Monoalkyldibromo compounds* (Pope and Gibson, 1907; Burawoy and Gibson, 1934 and 1935).—The monoethyl and mono-*n*-propyldibromoauric compounds have been studied in some detail and their constitution is represented thus:



These compounds decompose slowly yielding alkylbromide and gold monobromide. Chemically the monoalkyldibromogold compounds behave as equimolecular mixtures of gold tribromide and the dialkylmonobromogold.

(*c*) *Cyano derivatives of organic gold compounds* (Gibson, Burawoy and Holt, 1935; Burawoy, Gibson, Hampson and Powell, 1937).—The dialkylmonocyanogold compounds differ from those previously described in that they contain four atoms of tervalent gold in the molecule. They have a symmetrical twelve-atom planar ring structure.

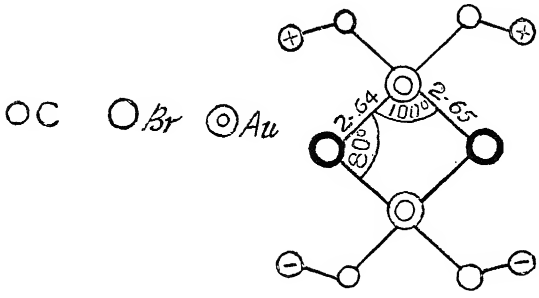


The dialkyldicyanodigold compounds are very sparingly soluble in organic solvents and they constitute further examples of mixed 4-covalent auric and 2-covalent aurous compounds.

The decomposition of these compounds furnished several facts of great interest, *e.g.*, *n*-hexane was obtained for the first time by the decomposition of a *n*-propyl compound.

(*d*) *The structure of gold compounds.*—Our knowledge of the structure of various types of gold compounds has been enriched as a result of X-ray crystallographic investigations of Powell (1937) at Oxford, Wells (1936) at Cambridge, and Cox and Webster (1936) at Birmingham. The planar configuration of the four valencies of tervalent gold and the linear configuration of the two valencies of aurous gold are now firmly established. The X-ray investigation of diethylmonobromogold by Powell showed that two gold atoms and two bromine atoms lie close together near the origin and that the molecule is $Au_2(C_2H_5)_4Br_2$. These four atoms form a rough square in a plane somewhat inclined to (001). The molecule projected on the plane of the gold and bromine atoms is shown below. The carbon atoms marked ⊕ and

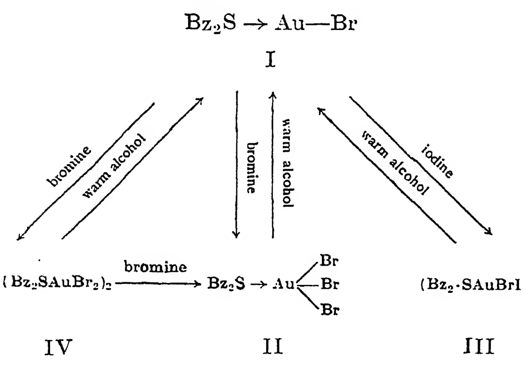
⊖ are respectively above and below the plane of the other atoms.



The planar and symmetrical distribution of the four valencies of tervalent gold in a non-electrolyte thus confirmed the same results obtained by Cox and Webster in the case of the salt, potassium bromoaurate $KAuBr_4 \cdot 2\,H_2O$.

Powell and Phillips have also completed the X-ray study of di-*n*-proplymonocyanogold $(Pr_2\,AuCN)_4$. They have discovered (1) association of four gold atoms in one molecule, (2) existence of the group $Au - C \equiv N \rightarrow Au$ and (3) direct linking of two propyl groups to the gold atoms. The shape of the molecule approximates to a square and the distance $Au - C \equiv N \rightarrow Au$ is the same for each side and equal to 5·18 A, which is in agreement with the value 5·28 A for the length of the group $Au - C \equiv N \rightarrow Au$ as derived from the available data on bond lengths.

(*e*) One of the studies of gold derivatives of organic sulphur compounds involved the reactions which are outlined below.



The colourless 2-covalent aurous compound (I) (dibenzylsulphidomonobromogold) and the deep red 4-covalent auric compound (II), (dibenzylsulphidotribromogold) have no unusual properties. But substances (III) and (IV) present interesting features from the structural point of view. Our knowledge of the physical and chemical properties of these substances is too meagre for determining the constitution of the substances in the solid state. Careful crystallographic and X-ray analysis is the only method of determining the constitution of such compounds, and it may be that such investigations will give useful information about 'complex molecules' generally.

K. R. KRISHNASWAMI.

GEOLOGY.

President: PROF. H. H. SWINNERTON, D.Sc.

DEVELOPMENT AND EVOLUTION.

IN his Presidential Address to the Section of Geology, Prof. H. H. Swinnerton deals with the relationship between "Development and Evolution". Starting from the earlier general conception of Von Baer and Hæckel of 'ontogeny' being a repetition of 'phylogeny', Prof. Swinnerton soon proceeds to point out that there is a fundamental difference between the views of these two great workers, which it is necessary to clearly appreciate. Whereas Von Baer and his followers propounded the view that "the young stages in the development of an animal are not like the adult stages of the other animals lower down the scale but are like the young stages of those animals" the followers of Hæckel maintained that "the adult stages of the ancestors are repeated during the development of the descendants, but are crowded back into the earlier stages of Ontogeny, therefore making the latter an abbreviated repetition of Phylogeny". The study of fossils, especially the invertebrates, seemed to reveal an increasing body of facts in support of Hæckel's theory, while the study of living forms did not lend support to this principle—Garstang expressing the opinion so recently as 1929 that "the theory of adult recapitulation is dead, and need no longer limit and warp us in the study of Phylogeny". It will, however, be seen that the idea of 'recapitulation' in the sense of summing up, is inherent in both Von Baer's and Hæckel's theories but the fundamental difference is that while for the former it is a recapitulation of *juvenile* conditions, for the latter, it is a recapitulation of *adult* conditions. The main point at issue therefore is whether or no *adult* recapitulation, either specific or general, does occur. It is on this point that there is a striking divergence of opinion between biologists on the one side and invertebrate palæontologists on the other. As Prof. Swinnerton points out "the fact that in matters of this kind, serious workers can hold such diverse views indicates the possibility that Nature's methods are equally diverse."

With this introduction, Prof. Swinnerton proceeds to consider the present position on this matter approaching the subject from the palæontological side, and points out that any consideration of the relationship of development to evolution must deal with the subject from two aspects—the *retrospective* and the *prospective*. "On the one hand, we must inquire whether the evolutionary changes of the past are reflected in development, and if so, to what extent. On the other hand it must also inquire whether future evolutionary changes of sudden or of sequential character are foreshadowed in development." It is obvious that these two

aspects are closely interwoven with one another and as Prof. Swinnerton points out, much confusion has crept into recent discussions of this subject due to a want of appreciation of their fundamental distinctness. Prof. Swinnerton also finds it necessary to clearly define the terms used in connection with these studies, so as to eliminate the possibility of confusion due to diversity in the shades of meaning attached to them.

Under the 'retrospective' aspect, Prof. Swinnerton refers to the classical work done by Carruthers on *Zaphrentis delanouei* and points out its great importance in the study of recapitulation. Examples have also been given from other groups of animals whose development has been studied in great detail in recent years, *e.g.*, the Orbitoides group among the Foraminifers, the gens *Gryphea incurva* among the Lamellibranchs and *Spirifer* among the Brachiopods. Under the 'prospective' aspect, Prof. Swinnerton discusses the importance of various phenomena such as Cœnogenesis (the appearance of new characters at an early stage of development), Proterogenesis (the extension of new characters from early to late stages of development), Deuterogenesis and Tachygenesis (the appearance of new characters at the latest stage in development and their extension to earlier stages), and Mutation; and in each case, refers to the evidence afforded by studies in different groups.

The address is a masterly review of recent work dealing with an important and fascinating aspect of the study of Evolution. L.R.R.

ZOOLOGY.

President: Dr. Stanley Kemp, Sc.D., F.R.S.

OCEANOGRAPHY AND THE FLUCTUATIONS IN THE ABUNDANCE OF MARINE ANIMALS.

The term Oceanography should not be used in the restricted sense to mean hydrography or the physics and chemistry of sea-water. It is much more comprehensive, and includes not only the physico-chemical work, coastal surveys, studies of tides and currents but also marine zoology, botany and parts of geology and meteorology. Great advances have been made in the study of the subject since the establishment of the Marine Biological Station 70 years ago at Naples. Several expeditions such as the 'Challenger' have been fitted out, and we have been made acquainted with oceanic and abyssal faunas and with the hydrography of ocean basins. Other aspects of study which could not be carried out by such expeditions have been taken up in marine biological stations, several of which have been established both in Europe and in America. A stage is now reached when a well-equipped tropical station in the Indo-Pacific region is urgently needed. State Fisheries Laboratories have contributed very largely to the study of Oceanography. Almost complete accounts of the natural history of a number of fish have been published. By this means fundamental knowledge that is necessary in the solution of several fisheries problems has been acquired. Progress in Oceanography has thus been due to the early expeditions, marine biological stations and fisheries departments. Zoological physiologists have added greatly to a correct appreciation of function in marine animals and life-histories of large numbers of animals have been studied with accuracy.

Years of study have convinced us that there are annual fluctuations in the abundance of fish, dependent on the events connected with their developmental stages. These fluctuations may be different in their intensity in different parts of the coast. Though much valuable information in this connection has been collected by the International Council for the Exploration of the Sea, still the precise reasons for good and bad spawning seasons in several cases yet remain obscure. In addition to these annual fluctuations there are what are known as long-period fluctuations which become superposed upon the normal annual fluctuations. Russel's work on the young fish obtained in the Plankton at Plymouth for the past 13 years throws a flood of light on the long-period fluctuations. There has been a decrease in recent years in the amount of larval fish of both summer and spring spawning forms occurring along the Plymouth coast. The Plymouth Herring Fishery also has declined very considerably recently. Studies by Ford at the Plymouth Marine Laboratory have shown that the abundant catches of 1924–25, 1927–28 and 1929–30 are to be regarded as normal annual fluctuations due to the great abundance of the 5-year old fish. But this abundance was not replaced by adequate numbers of younger fish in later years and the fishery has been greatly affected. This depression in the Plymouth area may be correlated with the lessening amount of phosphates in the sea-water on the Plymouth coast which has become increasingly evident from the year 1931 as shown by Dr. Atkins. The renewal of the phosphates in the channel is dependent largely on the inflow of Atlantic waters. It is likely that the reduction in the phosphates is to be traced to the changes undergone by the normal water movements off the mouth of the channel. That such changes do take place has been shown by the discovery of Russel who regards species of Sagitta as indicators of water movements. The 94 per cent. of *Sagitta elegans* and the 6 per cent. of *Sagitta setosa* in his tow-net hauls of 1930 became changed into 17 per cent. for *Sagitta elegans* and 83 per cent. for *Sagitta setosa* in the next year when the deficiency of phosphates and the decrease in numbers of summer spawning fish first became evident.

The next part of the address is devoted to a consideration of the changes which affect the biological condition of the water and it is suggested that the causes for these long-period fluctuations may not be same everywhere but may be brought about by slightly different factors in different places. A thorough investigation of the ocean movements in the Atlantic spread over a period of several years alone can make clear

what at present remains very largely obscure. These problems are receiving increasing attention in Europe and in America. Speaking of the fishery work done in the British Empire, Kemp is profoundly dissatisfied. In South Africa and in India with immense possibilities for fisheries development, facilities for work are very inadequate. There is a lack of fundamental knowledge that is so essential to future work in Fisheries. In India Japanese trawlers are taking full advantage of the situation and are exploiting the Bay of Bengal in ever-increasing numbers. Only by systematic and strenuous work continued over several years can the basic knowledge that is necessary for the solution of important fisheries problems be obtained. To this aspect of work more and more attention must be paid throughout the British Empire and the address concludes with a fervent hope that "when, in God's good time, the nations begin to turn their armaments to better uses, and the mass production of ploughshares begins.. it will not be forgotten that there is also a harvest of the sea." R.G.I.

GEOGRAPHY.

President: PROF. GRIFFITH TAYLOR.

CORRELATIONS AND CULTURE.

A Study in Technique.

"CORRELATIONS AND CULTURE," formed the topic of the presidential address of Prof. Griffith Taylor, to the Geography Section of the British Association for the Advancement of Science, held this year at Cambridge. Suggesting the definite need for geographical studies and mapping of geographical data in any valid interpretation of the concept of culture, the address is dealt with under three main divisions. In the first, is considered the field of Cultural Geography; in the second, is discussed a technique found very useful in research in that subject; and in the third, is suggested the modifications, in the aspects of culture, necessary in a modern general education.

Geography is defined as "the science concerned with description, localisation and explanation of data which relate man to his material environment", and its essential feature is indicated to be the localisation of data (*i.e.*, the charting of data in question) with a view to explaining their distribution. The close relation of geographic studies to both physical and social sciences is emphasised and the way in which geography links the four *Environmental* Sciences of Geology, Physics, Astronomy and Botany with the four *Human* Sciences of History, Anthropology, Sociology and Philology is indicated. Students of History are apt to belittle the value of geographic data in investigating their problems, which should not be the case. The charting of geographic data is helpful to social sciences, and the aid which geographers can give to historians is illustratd by examples from the Weald and from the Blue grass country of Kentucky. In both these areas, the characteristic cultural development is shown to be primarily dependent on conditions of geological structure. The use of *isopleths* (lines of equal abundance) in interpreting the essential features of the renaissance is clearly pointed out. There is doubtless an inherent disadvantage in geography in the large number of facts to be assimilated in its study, but it is pointed out that memorising facts need never be a vital factor in geography and that students in Cultural Geography should learn to doubt and deduce rather than memorise the innumerable facts presented without co-ordination.

In the second section, which forms the main purpose of the address, is shown by numerous illustrations, that by careful mapping of the distribution of several Culture-facts and correlating them, the investigator can deduce the cradle land of various cultures and the order of their evolution. Cultural evolutions, like biological, are responses to environment, though considerably more rapid. The 'zones and strata' concept of the geologists and biologists, adopted in their field of research on biological evolutions, is pressed into service to deduce the various culture spreads. This theory, in brief, premises that, primitive races, culture, religion, etc., evolved as a response to environment in a common cradle land, migrate and spread outwards giving place to others which may arise there later; and consequently, primitive cultures do not belong to places where they are now seen but have migrated there, from their places of origin. From an extensive study it is inferred that Central Asia has been the most appropriate environment for the racial and cultural evolutions: and it is put forth that the primitive races, languages, cultures and religions were all evolved in that cradle land and spread outwards to different continents in the efflux of time.

Prof. Griffith Taylor believes that the primitive man was differentiated into the five major races long before the later races reached Western Europe, and that this evolution took place in Central Asia. Consequently he holds that the negroes and negritoes also, evolved in the common cradle land of Central Asia and not in Africa as held by others. Based on the inference of geographic conditions which existed in early times, the migration of races from the common cradle land to different parts of the world, along suitable corridors, is then described; and it is shown that all the present progressive nations of the world are built up of the same three stocks, 'Alpine, Nordic and Mediterranean'. It is held that cultural differences could be easily bridged over and assimilated: but a race barrier, such as that which exists between the earlier evolved negro stock and the later evolved stocks, cannot be so readily adjusted.

The actual difference between race and culture is then discussed. Difference of culture is shown to have no bearing on racial differences. For instance, the Jews have a different culture, language and religion but they are composed of the same races as the other European nations. To express such groups linked purely by cultural characters, the extension of application of the

word 'Cult' is advocated. It is not correct to say that there is a Jewish race in Europe, or a French race in Canada, but it is logical to talk of a Jewish or French Cult.

The 'Zones and Strata' concept has next been applied to trace the linguistic relationships, and it seems to offer clues as to the relationship between the Aryan, Basque, Altaic and other groups. It is believed that the Aryan languages originated from near Turkestan and spread outwards from there. It is doubtful who first spoke the Aryan language, but from the 'zones and strata' theory it is deduced that the Nordic races, however, did not speak originally this language, but spoke Finnish or some other allied non-Aryan language. The growth and spreading of several cultures are next discussed in the same way, by the application of the technique of the zones and strata concept.

Prof. Griffith Taylor classifies the geographers into three groups: theocratic, geocratic or environmental, and possibilist. He believes in the environmental control or 'Stop and Go Determinism', differing in this respect from the orthodox views of many historians and geographers.

In the final section, a plea is put forth for a drastic revision of the programme for a general cultural education. The cutting down of the study of classical languages like Latin and Greek, and giving greater attention to Biology which deals with the evolution of man as an animal. History which deals largely with the growth of his ideals and institutions, and thirdly Geography which deals with his present, often varying, environment are stated to be necessary. It is considered desirable to swing the attention of youth, for a generation or two, from the problems of Physical Science to the more difficult and dangerous problems of Social Science. There is no risk to day, as it was in the past, in stating that the earth is round, revolves round the sun, and is of small importance in the Cosmos. But there is grave danger, in many circles in stating the truth about Communism, Socialism, etc., which conflict with established interests. These creeds are cultural facts and they are today more vital to the man of culture than is the well recognised and valuable culture based on art, music, or classics. Therefore, the student of Cultural Geography can feel certain that he is working right on the forefront, in man's progress towards a higher type of civilisation.

B. R. R.

ECONOMICS.

President: R. F. HARROD.

SCOPE AND METHOD OF ECONOMICS.

ENCOURAGED by the recent outcrop of speculation upon the methodology of economics, Mr. Harrod felt an 'inner urge' to say something on it. The pure theory of classical economics may be divided into (1) the theory of value and distribution and (2) the maxim that productive resources should be so distributed among occupations as to yield an equimarginal social net product. The first professes ability to deduce from given circumstances general laws of rigid demonstrability and certainty concerning the casual succession of events having an empirical basis. These laws are deducible from the law of diminishing utility or law of demand, an axiom of the highest possible degree of empirical probability. But the degree of its generality is so great as to render the power of prediction almost nugatory. Recent attempts of economists to get greater knowledge of causal sequences than is vouchsafed by the law of demand (*e.g.*, trade cycle theories) have led to the undesirable results of making economics conjectural. Having said so much as introduction, Mr. Harrod proceeds to deal with the subject under four heads.

1. *The Economic Criterion.*—First about the choice of the criterion itself. Critics like Robbins say that the economist must only state the sequences of events, but not offer advice. This view claims both too much and too little; too much because it gives an exaggerated idea of the economist's power of prediction at the present juncture, and too little, because it claims that his advisory power is confined within the narrow limit of his predictory power. Any definition of the economist's advisory rôle which does not realise the value of his references to the analytical map is unrealistic and fails to do justice to the usefulness of the economist. Even when a specific end is furnished to him he has to employ his own criterion. Next, the criterion must be tested in the real world. The construction of a realistic map involves important analytical work in the form of propositions *re* the equality of price to the sums of rewards of agents contributing to production, etc. Economists of the past were too hasty in assuming exact correspondence between the facts of real life and those of the map, and exalted the principle of *laissez faire*. A large part of Pigou's welfare economics, as well as recent theories of imperfect competition, try to recommend interferences to make it correspond to the map.

2. *General Theory of Value and Distribution.*—How is the Law of Demand derived? Not from the markets in the ordinary sense or from the psycho-physiological principle; but it is an *a priori* axiom derived from that homogeneity and heterogeneity together resident in exchangeable object, and is seen by observation, introspection and assumption. The predictory power cannot go far, in the absence of more precise quantitative knowledge. But is this the centre of economics? It seems that the predictory power cannot be enlarged further from the value theory, and that more specific laws would have to be based on detailed empirical work and would be highly conjectural. But if it is not to be the main avenue for future developments, then the general theory of value must itself be displaced from its central position.

3. *Dynamic Economics.*—Out of the wide field of possibilities for quest for causal laws outside the law of demand. the first for consideration is dynamic economics. There ought to

be alongside of the static theory a body of laws relating to the increase of economic magnitudes, to be constructed with the aid of a few empirical generalisations. New formulations are to be made regarding the movement of economic magnitudes under the influence of growth of population, savings, inventions, etc., on simplifying assumptions like frictionless surface, etc. The concept of motion under the influence of steadily operating forces attained in the form of a few basic empirical laws of wide generality, may yield, in connection with the study of mutual implications, an elaborate structure of deductive theory. An instance of it is the proposition that of Keynes, that at a given rate of interest people will save a larger absolute amount from a larger income.

1. *Empirical Studies.*—Causal laws must be supported by empirical evidence, must be mutually consistent and must use the analytical map. The work consists of the collection of new statistical material and also the application of the statistical technique. The objection to the more deductive method is that a crucial experiment is impossible, and it is difficult to test hypotheses by the collected data of observation. This strengthens the case for refined statistical treatment of observed facts. (However, Mr. Harrod has many points against the 'laments' of Mrs. Wootton.)

" I believe that we may be on the eve of a great advance in economic theory, taking us right outside the ambit of the static system of equations. The wealth of statistical data, together with the indications resident in the trade cycle that the succession of events is governed by laws still undiscovered, should be a spur to the inventiveness and enthusiasm of every student....any day he may light upon some general relation of wide validity satisfying to the intellect and capable of yielding vast benefit to humanity ...... The task of the economist is rendered arduous by the intractable nature of the phenomena which he has to study; but he is better placed than other social students, and if he turns a deaf-ear to cavillers, the past achievements of his subject and its present vitality may buoy him up with a reasonable hope ". Thus concludes this weighty address.

P.J.T.

ENGINEERING.

President : PROF. R. V. SOUTHWELL, F.R.S.

THE CHANGING OUTLOOK OF ENGINEERING SCIENCE.

As engineering knowledge and the requirements of industry are rapidly changing, planning of engineering education is necessary. Practical and academic sides of engineering should be regarded as one undivided whole. Engineering science is defined as the academic aspect of engineering and the author discusses it under three heads,

1. TEACHING.

Industrialists have lost their old time contempt for the engineering graduate but the qualities demanded now are new. The college curriculum tends to overcrowding, each enthusiast desiring to include a little more of his subject. The final result is a syllabus which the average student cannot assimilate. The industrialist now engages specialists for his special problems and demands from the graduate ability to take wide views, to think, to negotiate and to control ; qualities which can be developed only in their undergraduate years given sufficient leisure for original thinking. The knowledge of engineering principles required is such as an average student should be able to acquire and can be tested by easy papers. The time table should not therefore be overcrowded. There is however need to co-ordinate the three years' college instruction with the two years practical training so as to form a connected five years' training carried out with a single objective.

2. RESEARCH.

Engineering research has become specialised and a tendency is observed to leave everything to the pure scientist. The attitude of the engineer to his problems is however entirely different from that of the pure scientist. The latter requires ideal conditions and materials. He is free to choose his path or alter it at his will. His shapes are not dictated by constructional or manufacturing requirements; nor his materials by considerations of strength or cost. The engineer, on the other hand, has to solve a problem as it is presented and some solution he must have even though it is only approximate. Engineering research requires the gift of visualisation and this must be fostered deliberately. The inevitable factor of safety must be reduced as improved methods are evolved. Owing to a margin of error being ever present in the engineer's data, he cannot copy exactly the scientist's methods, but must develop a method of his own. The "Relaxation method" devised by the author has been able to solve many problems hitherto regarded as difficult. It is not to be imagined that engineering does not aim at accurate calculations. On the contrary, correct calculations are more important for them as the real check, *viz.*, test to destruction, is both costly and dangerous. Engineering research should aim to point out the " disturbing factors" in the scientist's solutions and to leave the scientists to solve the new problems thus presented.

3. RELATIONS TO COMMUNITY.

The accusation is sometimes levelled against scientists and engineers that they are responsible for the modern wars and their horrors. This is entirely groundless. Wars have always been made by communities and not by engineers; nor is the horror peculiar to modern wars. By their search for knowledge, scientists and engineers have opened up vast sources of power. Knowledge is non-moral. Poisons and deadly weapons may be used for the happiness of a community in preventing disease, etc. It is

not the fault of the scientist if these powers are used for evil objects. The engineer has been silent in the past. As a member of the community he has a duty to perform. He can instil into the mind of the public a clearer notion of the real aim of scientific work, which is to seek the truth, believing that the gifts of science hold potential good. K.C.C.

ANTHROPOLOGY.

President: PROF. V. G. CHILDE.

THE ORIENT AND EUROPE.

PROF. V. G. CHILDE, in his Presidential Address in the Anthropology Section before the last meeting of the British Association, upheld the claims of Pre-history as an experimental science based upon solid facts like "relics and monuments". Comparing the Oriental culture with European Prof. Childe supported the axioms propounded by Montelius in 1899. He described in detail the recent excavations in the Near East specially that of the German school at Erech and of Mallowan and Speiser in Syria and Assyria. Prof. Childe puts the date of the Erech finds at 4500 B.C. roughly, while that of the earliest stratum at al' Ubaid at the sixth millennium B.C. The Anatolian chalcolithic is assigned to fourth millennium B.C. The earliest cultures of the Fertile Crescent are so unlike anything known in Europe "as to seem incommensurable", but Heurttley's excavations in Macedonia have established connections between Asia and Europe and the Anatolian ancestry of the Early Macedonian Bronze Age cannot now be denied. The Macedonian relics can be well compared with the Vardar-Moravian culture of the Danube Basin and a cultural continuum between the Aegean Coasts and the Danube Basin seems to be likely.

Referring to Banner's researches in Hungary and Butler's investigation in Germany, Prof. Childe said that they had no counterpart in the Orient. The earliest bronze objects of Europe are associated with the Aunjetitz culture which can be traced back to 3000 B.C. in the Orient. The earliest neolithic culture of Europe is revealed by Danubian I, but in the Orient the finds of early settled cultivated life below the Tel Halaf village appear to be more advanced than that of the ancient Danubians. Objective proofs of cultural continuity between the Near East and Central Europe by diffusion are yet wanting and is much to be expected from the Balkan regions which is unexplored.

S. SARKAR.

PSYCHOLOGY.

President: DR. R. H. THOULESS, M.A., PH.D.

EYE AND BRAIN AS FACTORS IN VISUAL PERCEPTION.

LIGHT ON THE PSYCHOLOGY OF VISUAL PERCEPTION.

DELIVERING the Presidential Address of the Psychology Section of the British Association for the Advancement of Science held recently at Cambridge, Dr. Thouless, M.A., Ph.D., has undertaken a survey and critical assessment of the psychological value or significance of the part played by the EYE and the BRAIN in visual perception. Not merely the sensitive retinal surface and the "Visual areas of the cortex", but, the "Whole system which includes retina, optic nerve, visual area of the cerebral cortex, and other sensory areas of the brain as well" would appear to constitute the physiological mechanism of vision.

In the first section of his presidential pronouncement, Dr. Thouless briefly states and examines the "Transmission Theory of Vision" which had enjoyed the support of such eminent investigators as Helmholtz, and which while over-emphasizing the importance of the activity of the retina, seeks to neglect or to relegate to a secondary position other factors. The Transmission Theory notwithstanding influential backing at the hands of the expert as well as the man-in-the-street, should be deemed defective. In the second section, "Experimental Objections to the Transmission Theory" are recorded. Sometimes differences in visual perception as in the case of yellow and red are due to difference in the bands of wave-lengths, of light and at other times the difference between perception of red-book and red-patch of the spectrum is due to no such difference. The adoption of the "Phenomenological" standpoint by psychologists paved the way for correct experimental approach to a study of vision in all instances whether or not accompanied by differences in local physiological stimulation. The main attack on the "Transmission Theory" came from Wertheimer (1912) who investigated the so-called "Phi-movement". Dr. Thouless suggests a simple experiment the apparatus being just an oval table-mat, or a sheet of cardboard and a pair of scissors. After setting forth three objections against the Transmission Theory, Dr. Thouless concludes reinforcing the view of Wertheimer that the "Sensation" corresponding to the conditions of local retinal stimulation as an element in a complex perception is a mere fiction. In the third section, "the whole case against the Transmission Theory" is presented. Offering an alternative explanation, Dr. Thouless suggests that the mind, or the brain acting to some extent as a unitary whole is active in perception responding to information given by the sense organs and not merely reproducing a pattern of stimulation from the sense-organs. Thus, the visual characteristic of an object should be understood or interpreted as the product of combined action of different activities of the visual cortex which also make their contributions to the other characteristics of the perceptual field. In the fourth section, Dr. Thouless examines "Individual Differences in Visual Perception", and points out that phenomena "are determined not only by the local stimuli but also by the perceived real characters of the objects causing the stimulus". In interpreting individual differences in visual perception, Dr. Thouless would like to speak of "Phenomenal regression" (in preference to constancy tendency as some have it) in respect of shape, size and colour. Is the phenomenal regression governed by any laws? Not necessarily fool-proof laws though. Notwithstanding individual differences, regularities are to be found. Dr. Thouless finds that the

tendency to see the real characters of objects *increases through life* being least with young children. Dr. Thouless suggests a hypothesis which seeks to do justice to the claims of both the so-called "Nativists" and "Empiricists". The tendency to phenomenal regression is congenital endowment but individual differences and idiosyncracies are the result of experience. What are the practical consequences of a theory of visual perception? The concluding (fifth) section is devoted to an elucidation of the practical consequences that flow from the theory advanced. For instance, a person with high phenomenal regression can drive a car better in traffic, phenomenal regression revealing a correlation with efficiency or ability to drive. Dr. Thouless takes stock of the situation in the concluding paragraph. Vision is not a function of the eye alone. Higher centres actively co-operate in vision. Mere sensory physiology of the eye is hardly a substitute for genuine psychology of visual perception.

Let me add only a very brief comment. The YOGA system of Indian Experimental Psychology has advanced the claim that *extra-sensory perception is perfectly practical politics*. Dr. Rhine's volume on E. S. P. has almost created a revolution in Psychology. Though Dr. Thouless makes no mention of it in his address, examination of the claims of E. S. P. must be boldly and courageously undertaken within the jurisdiction of laboratory discipline.

R. NAGA RAJA SARMA.

BOTANY.

President: PROF. W. STILES, F.R.S.

THE GENERAL PHYSIOLOGY OF THE PLANT CELL AND ITS IMPORTANCE IN PURE AND APPLIED BOTANY.

AFTER tracing briefly the history of development of Cell physiology, Professor Stiles classified investigations in general Cell physiology into four groups, namely "(1) those concerned with the chemical and physical constitution of the protoplasm and other cell constituents; (2) the study of enzyme action; (3) those dealing with absorption and excretion of water and dissolved substances which have, for the sake of convenience, generally in the past been referred to as problems of cell permeability; and (4) those concerned with respiration. The first two are largely biochemical studies, and it is with the more purely physiological problems of respiration and salt and water relations that I propose mainly to deal in this address." Although investigations into these various aspects of vital activity have developed to a large extent independently, they are closely connected. Thus, for example, passage of water into and out of the cell, absorption of dissolved substances by the vacuolated cell, and enzyme action and respiration are all functions of protoplasm. As to the nature of protoplasm itself, Professor Stiles said, "At present, then, we must be content with recognising in the protoplasm a system in which an essential feature is the possession of a large internal surface, with all that this involves, in which there are various phases of different chemical composition, a composition roughly but by no mens accurately known. One of the characteristics of this system is that, in so far as it can be regarded as a system in equilibrium, it is in a state of dynamic, not static equilibrium, for all the time it is absorbing oxygen and giving out carbon dioxide."

After a detailed examination of work on respiration of normal plants and succulents, he says, "While then data are accumulating which indicate the linkage of anabolic process with those of the breakdown of sugar, it is important to note that there is no evidence of the formation of products other than carbohydrates. Is it possible, however, that syntheses of more complex substances are indeed involved, and that we have here a dim glimpse of the mechanism for the production of these substances, and that along with the formation of sugar or some intermediate there may be also the formation of protein or other complex substances; that, indeed, we have here the mechanism by which the carbohydrate is brought into a suitable form for combination with nitrogenous and other compounds?"

Professor Stiles then proceeded to examine in detail the relation of respiration to absorption of electrolytes and comes to the conclusion that the relationship of respiration to the absorption of salts by plant cells, *viz.*, the accumulation of salt depends on the vitality of the cells and that the maintenance of this vitality depends, as has been long recognised, on the presence of oxygen, either because aerobic respiration or some other process requiring oxygen is essential for this maintenance of vitality, or because in the absence of oxygen the accumulation of carbon dioxide and other products of anaerobic respiration adversely affects the functioning of the protoplasm.

The fundamental importance of the principles of general Cell physiology in plant metabolism is next emphasised. The process of photosynthesis, the passage of the products of photosynthesis from the assimilating cells to the phlœm and related phenomena are all based on the principles of Cell physiology in as much as they depend on the activity of specialised cells and tissues. Even ecological studies, especially the higher branch, *i.e.*, the detailed investigation of the functional relations of plant associations to their surroundings are based on such principles.

Professor Stiles concludes, "With the ever-increasing mass of knowledge in the various branches of botany, an increase which is especially noticeable to-day in those aspects of our subject which are undergoing rapid development, physiology, mycology and genetics with cytology, it is impossible for any one to be an active worker in more than a relatively very small field of botanical endeavour. We sometimes meet with reference to a mysterious gentleman called the 'general botanist' who is expert in general botany, as someone distinct from the morphologist, physiologist, mycologist or other worker in a defined field. But in these days, when to make any contribution to knowledge necessitates

specialisation, there can indeed be no such person as the expert in ' general botany ', for there is, indeed, no such subject. But in whatever part of our subject our own special interests may lie, we can still appreciate the efforts and aims of workers in other fields, and realise the bearing of work in these fields on our own problems, and in this sense, we are all general botanists, that is, just botanists.

"For if 'general botany' as something distinct from ' botany ' is a myth, there is no doubt that the various branches of our subject are related in the whole. In this address I have tried to indicate not only the scope and present position of our knowledge of the general physiology of the cell, but where this particular part of the science or of plants comes into contact with other branches of botany, and how the application of a knowledge of the facts, principles and methods of Cell physiology may be expected to lead to an increase in knowledge, not only of the physiology of the plant, but of other aspects of botanical science and of its industrial applications."

P.P.

EDUCATIONAL SCIENCE.

President: MR. J. SARGENT.

THE FUNCTION OF ADMINISTRATION IN PUBLIC EDUCATION.

MR. J. SARGENT delivered the Presidential Address on the ' Function of Administration in Public Education ' to the Educational Science Section of the British Association for the Advancement of Science. According to him the Educational Science comprehends not only the philosophical principles upon which the educational practice is based, but also experiment and research into method and as such the subject deserves inspection by the Educational Scientist. In so examining the question, he dwelt at length on the administrative machinery, namely, Local Education Authority, and described the function of Administration as a method of transacting public business, cheaply and quickly. Administration expresses itself through two functions—the Legislative and the Executive, and the Local Education Authority is virtually the Executive and Central Government being Legislative wholly.

By a process which is at once historical and natural, the legislative side of administrative activity has remained largely in the hands of Central Government, though it would be to fall into an error which professed experts have not always avoided, if the fact were overlooked that in many instances experiments legitimately conducted by local authorities within the powers conferred upon them by Acts of Parliament have often led to new ideas and consequent legislation.

The gradual change in the conception of the function of the State in relation to the individual citizen which has marked the last century and with increasing emphasis, the last quarter of it, has resulted in a vastly increased interference by the State in the goings and comings of the ordinary citizen.

The growth in this business of Government, as in other business, has forced home the need for administrative devolution, with the consequent rise of local government as the machinery through which much of the will of Parliament must be implemented.

There is one aspect of this relationship, however, which is important, and that is the financial one. On the wider issue we may rest content with the fact that, whatever arguments may be adduced or principles invoked, so long as there are local administrators they will continue to pursue the laudable object of getting as much money and as little interference from the central authority as they possibly can. All the difficulties seem to arise from the present nature of the Local Government bodies themselves. The first difficulty would appear to lie in the unit, *i.e.*, in the size and geographical distribution of Local Government.

Apart from the questions of size and population, Local Education Authorities also vary greatly in their financial resources as regards both their own rateable value and the contribution which they receive from the Exchequer towards their net expenditure. In fact, the whole question of the financial relationship between the Central Government and the Local Government is one which calls for an immediate and comprehensive review.

Then again Authorities vary very much in their character, some being purely rural, many purely urban, while others contain a mixture of the two or are in process of transition from the former to the latter.

It is true that many of these difficulties can be and are in fact being overcome by co-operation between the authorities concerned, but it should be pointed out that while co-operation ranks high among the blessed words in the educational vocabulary, it usually involves a compromise and is never the ideal method of administrative procedure.

The next problem is concerned with the personnel of the Local Education Authorities. The personnel is divided into the amateur and the professional elements, or the unpaid and the underpaid as frequently expressed. The amateur element is again divided between persons co-opted for their knowledge of and interest in education, and others elected by the people not solely, because they are known to possess either or both of these qualifications.

The most serious aspect of the problem is the steady and even accelerating deterioration in the amateur personnel which has taken place since the War. This is particularly marked in the case of the elected representatives of the people. Consequently local administration is being progressively denuded of persons actively engaged occupying positions of responsibility in industry and commerce.

There seems no sign whatever that either of these tendencies is likely to lose its effect. Everything in fact points in the other direction and the result is already apparent in the increasing tendency of Education Authorities to consist of people who have retired from work or have

never had work, or who are in fact professionals rather than amateurs because, as officials of political or other associations it is expedient for them to become members of local education authorities from the point of view of promoting the objects which their associations have at heart.

There is, however, a risk, which is more than theoretical, of intellectual dishonesty creeping into the discussion of educational affairs when the Authority contains any substantial number of members who are pledged to a set of opinions which may have a cross-bearing on purely educational consideration.

Suggestions.

It is, however, possible, for practical experience and even *a priori* reasoning to suggest certain of the attributes which the ideal Local Government unit should possess.

(1) The administrative unit should be large enough to be able to provide the variety of services which a modern community requires, but not so large that the day-to-day discharge of routine administration necessitates a rigid or bureaucratic attitude towards the problems presented for solution.

(2) From the economic point of view the authority should be sufficiently large to be able to obtain good contracts for the supply of the various materials which it requires. When this stage is reached the question of devolution becomes just as important as that of centralisation at the early stage.

(3) The redistribution of areas in a manner that none of them may in future be exclusively rural or exclusively urban, is another important matter in this connection. This is a proposition which has commended itself widely to many social reformers who have advocated a regional organisation for Local Government.

(4) To some extent the establishment of geographical units of a more uniform and rational size would contribute towards the solution of the major difficulty of personnel because while it is true that some small authorities enjoy admirable committees and officials, some of the larger ones are notoriously below standard in these respects.

Unless people who are competent to govern can be made to realise that the preservation of liberty must depend on the capacity of those who voluntarily serve the community, that is, unless people are moved in greater numbers to offer themselves for public service by the Socratic urge, namely, fear of being governed by worse people than themselves, the prospect of arresting the deterioration in the amateur personnel of local authorities is small.

Local Government will have in future to counteract the deterioration in its amateur element by a corresponding improvement in the professional element, that is, it will have to look to recruiting better officials in the future than it has recruited in the past. This is not simply a matter of higher salaries, it is more a question of placing the training and status of the Local Government officer on a basis at least equal to that of the central civil servant. Speaking in mundane terms, the educational administrator should have had a University training and some experience as a teacher in one branch or other of the education service. It is essential that he should possess the qualities of a sound administrator, that he should know how to initiate, when to delegate, when and where to advance, how to endure setbacks—above all, how to handle men.

Finally he must beware of the hardening effects of custom and precedent. The needs of society are changing rapidly and it is the function of all educators to study these needs and consider how best they can be met. At its highest this demands from him a philosophy of life in which he is compelled to study continually the philosophical basis of education and the principle on which this great human science has developed; at the worst he falls back on Pope for comfort and inspiration

"Whatever is best administered is best."

K.R.R.

AGRICULTURE.

President: Prof. R. G. Stapledon, C.B.E., M.A.

LEY-FARMING AND A LONG-TERM AGRICULTURAL POLICY.

PROFESSOR STAPLEDON has rendered a real service by calling attention to certain defects in the prevailing agricultural practices and the importance of ley-farming or rotation farming in any rational long-range agricultural policy. A ley is land sown with grass for a short period of one to two or more years due to be ploughed up at the end of the definite period in rotation with other crops. He advocates three basic principles as fundamental to such a long-range policy; firstly, the maintenance of as large and contented a rural population as possible as the basis for increase of total population; secondly, maintenance of the largest possible acreage in a highly fertile and always ploughable condition; and thirdly, farming methods which permit of the maximum flexibility in commodity production. He accordingly evaluates farming systems from the criteria of their flexibility for commodity production, supply of feeding stuffs, the maximum needs of the soil for the maintenance and enhancement of its fertility and the amount of labour involved. Professor Stapledon is a strong advocate of ley-farming or alternate farming which secures the harmonious combination of animal and crop-husbandry. He condemns permanent grass farms as they contribute nothing more valuable than inferior hay to the winter ration and contain the minimum acreage in a ploughable condition and necessitate the largest dependence on imported feeding stuffs. He also condemns the non-descript farms which have permanent grass-lands with no rotation. Arable farming whose chief object is the production of cash crops such as market gardening errs at the other end in being dependent on extraneous sources for farm and stable-manure

necessary for soil-fertility. He recommends as important from the point of view of national welfare the arable-grass or grass-arable rotation. This system of periodical rotation between grass and crops is highly commended by him as farming which has reasonable demand for labour which is less dependent on imported sources for feeding stuffs and maintains the acreage and the farmer in a condition of maximum flexibility for commodity production. The rotational grass-lands (leys) are better managed than permanent grass-lands. Permanent grass-lands harbour the organisms of disease, deplete the soil of lime and are not well-suited for grass silage. Permanent grass makes the land weedy, and has a shorter growing season and yields less grass than leys. The ley further more affords great scope for special treatment so as to provide grass when most wanted.

Regarding the question as to the best course in ley-farming Prof. Stapledon recommends 1 to 2 year deep-rooting hay leys and 4 to 6 year leys for grazing only. He concludes with the suggestion to conduct a survey of the farms and farmsteads for suggesting the ways and means of bringing grass-lands under the plough. Prosperity in agriculture is a function of working capital for equipment. To this end Prof. Stapledon recommends the American idea of group loans, a master-borrower being given a tractor and necessary equipment to plough up the derelict grass-lands. Any well-wisher of agriculture cannot be too grateful for the well-considered ideas of Prof. Stapledon for improving the efficiency of farming to promote individual and national welfare. T.G.R.

CONFERENCE OF DELEGATES OF CORRESPONDING SOCIETIES.

President: RT. HON. THE EARL OF ONSLOW, G.B.E., P.C.

THE IMPORTANCE OF NATIONAL PARKS IN THE PRESERVATION OF THE FAUNA OF GREAT BRITAIN.

THE President has rightly tackled a subject which demands special attention by reason of its unlimited educational, scientific, economic and national value. The Earl, at the very outset, defines what is meant by a " National Park considered internationally ".

Thus the expression " National Park ", " shall denote an area (*a*) placed under public control, the boundaries of which shall not be altered or any portion be capable of alienation except by the competent legislative authority, (*b*) set aside for the propagation, protection and preservation of wild animal life and wild vegetation, and for the preservation of objects of æsthetic, geological, prehistoric, historical, archæological, or other scientific interests for the benefit, advantage and, enjoyment of the general public, (*c*) in which the hunting, killing or capturing of fauna and the destruction or collection of flora is prohibited except by or under the direction or control of the Park authorities. "

" In accordance with the above provisions facilities shall, so far as possible, be given to the general public for observing the fauna and flora in national parks. "

" The term ' strict natural reserve ' shall denote an area placed under public control, throughout which any form of hunting or fishing, any undertakings connected with forestry, agriculture, or mining, any excavations or prospecting, drilling, levelling of the ground, or construction, any work involving the alteration of the configuration of the soil or the character of the vegetation, any act likely to harm or disturb the fauna or flora, and the introduction of any species of fauna and flora, whether indigenous, or imported, wild or domesticated, shall be strictly forbidden; which it shall be forbidden to enter, traverse, or camp in without a special written permit from the competent authorities; and in which scientific investigations may only be undertaken by permission of those authorities. "

" You will see that not only do the African Powers contemplate the creation of National Parks but also of another type of reserve which they denominate a strict natural reserve. This was put in at the instance of the French Government who were anxious to provide for the creation of areas for the preservation of fauna and flora to which the public should not have access except under very definite restrictions; that is to say, they were to be created for purely scientific purposes, while the National Parks are to afford as much access to the general public as is possible compatible with their reasons for existence. Now in England we are apt to be rather more loose in our terminology and National Parks cover a very wide field—in fact, they cover any natural reserve or open space to which the public have access regardless as to whether they are to be devoted to the species of fauna and flora or not, and to-day I propose to devote myself to the methods of utilising the National Parks of this country on the lines contemplated in the African convention. I may say that there are a number of National Parks throughout the world devoted to fauna preservation. In Africa, for example, there are the Parc National Albert in the Belgian Congo and the Kruger National Park in South Africa. The success that has attended the creation of these parks might, I think, tempt us to try and do something of this kind in this country. "

The President refers to the policy of the Committee which has already been formed in England. According to this Committee the Government should:

(*a*) Declare that the establishment of National Parks is an essential national service.

(*b*) Set up, as chief and central agents, two National Parks Commissions (one for England

and Wales and one for Scotland, with a joint committee co-ordinating the two).

(*c*) Provide funds.

Co-operation of the various learned Societies in England has also been offered as they are all keenly interested in the matter. The Earl then discussed the suitability of a place in Great Britain for the establishment of a "National Park", and mentioned the various species of animals which might form very suitable inhabitants of the proposed National Park in Great Britain.

As regards financing such an establishment "People are apt to be frightened at the cost of buying a large area of land and maintaining it, but in the first place private individuals acquire deer forests and what is possible for a private individual should not be impossible for the public generally either under the Government or by means of public subscription. It would be costly but not necessarily ruinous."

"Then as regards maintenance, in the first place there would be an income coming in as there is in the National Kruger Park, which makes quite a handsome income. There would have to be, of course, an hotel or rest-house or something of that kind, and roads and foot-paths would have to be made so that people could get about and see the animals. A number of keepers would be required corresponding with the stalkers on a forest, probably rather less than a forest needs. But there would not have to be nearly as many ghillies, pony men, dog men and so forth. A few to act as watchers and keep off poachers and a few to keep sightseers from disturbing the sanctuary would be all that is necessary. Indeed, I do not believe that the number of people employed would be as great as in a forest, so that I do not think we need be unduly terrified either by the cost of acquisition or of management."

"And now I come to the last point, namely the method of management, and here I would like to refer you to the ideas which have been put forward by Sir Peter Chalmers Mitchell."

"He advocates a scheme whereby the arrangements for the popular functions of a National Park would be entrusted to delegates appointed by Edinburgh, Glasgow, Dundee and Aberdeen, working with delegates appointed by the Council or Councils of the county or counties in which the Park was situated. He would add to the Governing Body of the National Park a panel of persons selected for their special knowledge of wild nature in all its aspects, at least one botanist, one zoologist, one geologist, and two 'field naturalists', one with special knowledge of plants, the other an ornithologist. He thinks these might be selected by the Principals of the four Universities, the President of the Royal Society of Edinburgh, and of the Highland and Agricultural Society. Moreover, apart from the staff concerned with the general regulation of the Park, there should be one warden or ranger selected by the Naturalist panel, whose sole duty should be the constant study of wild life in the Park and all its fluctuations."

The scheme put forward by the President of the British Association deserves particular attention to the people of this country. In India establishment of several National Parks in suitable places in the various provinces will be required in consideration of her rich and great variety of fauna and flora. It is well known to biologists that there is a close association between floristic and faunistic composition. Therefore in a National Park not only the fauna (on which more stress has been laid by the Earl) but also the flora should play an equally important part. The Government and the public in this country also are aware of the importance of preserving our indigenous fauna and flora. Steps, I infer, have already been taken in the previous forest reserves in this country to effect a better control for the preservation of the wild plants and animals. In any case a strong representative Committee, as suggested by the Earl, consisting of experts from the Government Departments, Universities, Societies and Clubs in India should be formed to establish National Parks in this country in a proper form. With the support of the public, aid of the Government and munificence of our generous and farsighted princes and the nobilities, the difficult question of finance can be solved. Young India must not lag behind in this aspect of biological advancement of the country.

K.B.

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" Spiritual Disarmament."

IF the Founder of Christian Religion were to reappear in Palestine or Central Europe, who can describe his feelings of shame and sorrow at the transformation of the "image of God" into a cross between Moloch and Puck. Human nature being the same all the world over, Eastern Asia is emulating the excesses of Europe. Even at the risk of provoking the laughter of the political Pharisees and the Aryan scribes, we reproduce below the canons of human relationship propounded by Him whose Church still nominally claims the allegiance of white civilization.

> " You have heard that it was said by them of old time, Thou shalt not kill; and whosoever shall kill shall be in danger of the judgment: but I say unto you, That whosoever is angry with his brother without a cause shall be in danger of the judgment: and whosoever shall say to his brother, Raca, shall be in danger of the council: but whosoever shall say, Thou fool, shall be in danger of hell fire. Therefore if thou bring thy gift to the altar, and there rememberest that thy brother hath ought against thee; leave there thy gift before the altar, and go thy way; first be reconciled to thy brother, and then come and offer thy gift."

The spirit of the Lord must have been upon Herr Hitler, when he pronounced the beautiful phrase, " Spiritual Disarmament " which is an excellent summary of the above sermon. But we know that neither democrats nor dictators are the modern representatives of this immaculate spirit, and their eyes, instead of being turned to the heavens, are fixed on armaments as the only argument of peace. What is most disconcerting is that the religion of the Church and the culture of the philosopher alike never wore white gloves for moderating and assuaging the influence of the primitive passions of their followers. It might almost seem true that both religion and culture as understood or as misunderstood, have a banality and inward dryness which are irremediable sins in the eyes of grace. As an element making for proportion, harmony and taste, culture is individualistic; as a basis of sacrifice, service and love, religion is equally individualistic. Their universal character though taught and defended by the scholar and the saint through centuries, is entirely static and fugitive, to which history bears ample evidence. Under

the impact of the dynamic forces of material progress, religion and culture seem powerless, and lose their natural predilection for the reasonable processes of compromise and arbitration as against the more summary decisions by force of arms.

In the language of modern imperialism which resorts to violence and warfare for spreading the new gospel of civilization, the boisterous phrases "racial equality", "cultural freedom" and "international justice" are simply unmitigated cant. It will be remembered that the League of Nations, which was to act as the fountain and source of international peace and harmony, refused, under the threat of the withdrawal of some of its original members, to accept the principle of racial equality as an underlying factor in the preamble of the Covenant of the League. If the original powers could guarantee the administration of racial justice in an absolutely impartial spirit, where is the objection to the full and unconditional affirmation of racial equality. This mental reservation is undoubtedly the cause of all the fearful developments with which modern statesmen are confronted, and once we grant racial and cultural superiority on the part of certain groups of people, it is only natural to expect that this superiority must express itself in aggressiveness. People have implicit faith in the egregiously false doctrine that superiority of culture is synonymous with superiority of physical power, and the logical conclusion of such facile acquiescence is the robust philosophy that superiority must supplant inferiority throughout the habitable globe. But culture and religion never possessed the large-hearted peaceable quality which legend associates with them, but, on the other hand, becoming subordinate to the dominating influence of politics, they have been accessory to bloodshed. Theoretically man is prepared to be bound to his God, but he prefers in all his activities to be divided from his fellow beings. Universal brotherhood of man is an abstract philosophic conception, and as an article of faith in the practical affairs of the world, it was found unworkable. We know that religion and culture always range themselves readily and whole-heartedly on the side of political power, when engaged in international conflicts which they bless and justify, though they may have ceased to be their direct provocative cause.

Can religion and culture be made a potent factor for peace? The answer to this question is "Yes, if we have a new religion and a new culture, not the bedraggled old ones". When Herr Hitler spoke of "spiritual disarmament", we thought that under the inspiration of a great apocalypse such as St. John witnessed in Patmos, he was on the threshold of propounding a new religion for his countrymen and through them to the world. But instead of wearing the Marriage Garment which according to the Presbyterian teacher, Solsgrace, typified inward purity, and instead of preventing the unhappy incidents from being perpetrated in Berlin and Munich, he has deliberately permitted these unworthy and unchristian acts to add a stroke to the fourth letter of his name. No body will regret more than his own ardent admirers that their great leader, with the indomitable soul of the elder Cato, should be immortalised in history by this outrageous supplement, while he had a fair chance of being classified with the blessed saints, if by his actions be had acquired the appellation of "Healer". What visions are opened out before our mind's eye by the phrase "Spiritual Disarmament"? Love, faith, hope, joy, peace and work. Hatred, greed, jealousy, passion and fear banished once and for all. Nations all the world over turning a new way of life. Brotherhood of man, service and sacrifice for fellow beings. Truth and non-resistance in the place of secret alliances and militarism. Fight against the evil of the spirit, not against the neighbour.

These and good many other things are contained in all the religious works of the world. What is it that has made them defunct, will they at any time become the active principles of the life of nations and of individuals? Is armament the necessary prelude for the reinstatement of peace? We are not appalled by the "race of armaments" for we are convinced that a point must be sooner than later reached, when the very deadliness of the weapons will make war eventually impossible. It is not improbable that science may still perfect such unthinkably terrible engines of war. Perhaps nations may then decide to bury them in the oceans, and evolve other solutions for mutual concord and world-wide peace. It is too premature to talk of "Spiritual Disarmament", when our hearts and hands are still unclean.

International Auxiliary Language.

INVENTIONS over inventions bringing peoples closer together like the telegraph, telephone, radio, aeroplane, television are being continuously perfected and yet very little attention is given to an invention which when adopted will give mankind the proper means for free communication. A common language is the one great invention that is needed to crown all others and give them their full value.

The advantages of such an International Auxiliary Language seems to be evident. International Meetings are made very difficult by the diversity of languages, there is great loss of time, confusion brought about by the necessity of using several languages, of translating from one to others. The selection of delegates is in many cases limited to those who know the official languages of the meeting.

Once such an International Auxiliary Language has been established these difficulties would disappear. Its study could be introduced even in the elementary schools. Much of the time now devoted to several languages might be given to the international language or to other subjects by most of the pupils who do not go in for philological studies. Translations might be reduced to one in the international language, and papers on subjects which have a limited number of specialists might be written outright in the International language with saving in time and expense and many other advantages.

The adoption of a natural language would meet with opposition on the part of all countries, especially the largest of another mother-tongue. Besides the learning of a natural language always requires long years of intensive study. At different times various languages have had successively a predominant position : Greek, Latin, Arabic, Italian, Spanish, French and now English. All these gave way except for English which seems at present to be dominant. But what will be its position in a few decades from now in the face of the growth of Russian, Chinese, Spanish, or some of the Indian languages, Portuguese ?

Therefore, most people interested in the question suggested artificial languages. In reality, the name of artificial language is a kind of tautology, because there is art also in the coarsest language. The more so in the literary language in which conscious selection, if not arbitrary, is more or less profound, more or less recognizable, but always noteworthy. But the designation of artificial languages covers the projects of languages constructed according to a determined plan. Such a language is not meant to supersede the existing national languages ; its ambition is to serve as a mere auxiliary language ; its purpose is not to suppress diversity, but to promote co-operation.

Although many great minds have given serious thought to this question of an International Auxiliary Language, from Descartes, Leibniz, Delgarno and Wilkins to Schleyer, Zamenhof, Couturat, Leau, Peano, Jespersen, many people considered this proposition as an impossible absurd task, amongst them many linguists ; but of late it seems that this opposition is breaking down (see debates at their meeting in Geneva in 1931).

At first philosophical languages were proposed, a kind of algebra of concepts which would lead to logical thinking. The first of these projects is due to Descartes. He submitted the plan of an universal language easy to learn, to pronounce and to write, which would help one's judgment representing distinctly all things so that it would be practically impossible to be mistaken. Descartes limited himself to the exposition of the project, but G. Delgarno and J. Wilkins submitted in the seventeenth century two detailed projects. Leibniz also left amongst his papers many notes relating to a philosophical language.

From these philosophical languages we go over to *a priori* schemes. In these the choice of the elements is made according to a classification, more or less strict, of the concepts. The last of these schemes is " Ro " by E. P. Foster.

From *a priori* we go on to mixed schemes. Grammar is always established *a priori*, but the vocabulary is selected from natural languages without exact criteria and with many changes due to the grammatical structure selected. Amongst these the best known is Volapük proposed by J. M. Schleyer, which was the first artificial language to obtain a wide diffusion.

After these came the *a posteriori* schemes. In these very little is arbitrary. The grammar is obtained by regularizing one of the natural languages or selecting from various

of them. The vocabulary is selected also from natural languages. Examples of these naturalistic languages are Esperanto, its modification Ido, Occidental, Interlingua or Latino sine flexione, Novial.

If the movement for an International language is followed, it will be seen that it is not the case of a multitude of projects without connection or relationship; but these projects are connected, they have a common base, a common idea. This idea as pointed out above has traversed three stages: the philosophical, the *a priori*, the mixed, and last the *a posteriori*. These last show a remarkable conformity. Their authors get away from the *a priori* basis. They adopt the principles of internationality, so that they differ less than two dialects of a natural language.

When Volapük was proposed by J. M. Schleyer in 1879–80, its followers organised at their Munich Congress of 1887 an academy called Kadem bevünetik volapüka. Its first president was M. Kerckhoffs (Paris). He was succeeded by W. Rosenberg (Leningrad) (1893–98). During the latter's term of office he began the compilation of the vocabulary of what became a new language called Idiom Neutral, decidedly naturalistic and not mixed like Volapük, but *a posteriori*. The academy changed its name to Akademi Internasional de Lingu Universal and M. A. F. Holmes (Rochester, N.Y.) became the next president (1898–1908). He was succeeded by G. Peano (Turin, Italy) who carried the *a posteriori* scheme to the limit. The Academy again changed its name to Academia pro Interlingua, and although open to partisans of any International Auxiliary Language, stands for the language created by G. Peano who had followed the suggestion of Leibniz to use for practical purposes a simplified Latin. G. Peano started to use Latino sine flexione in 1903 and since then he has worked at the international vocabulary made up of words in international usage and those of Latin still living in the neo-Latin languages and in English and others. The grammar simplified in the extreme is considered by many to have many points in common with Chinese.

Recent Discoveries of Fossil Algæ in the Cretaceous Rocks of S. India.

By Prof. L. Rama Rao.

(Department of Geology, University of Mysore, Central College, Bangalore.)

ABOUT seven years ago, the writer of this article reported through the columns of *Nature*[1] the first discovery of fossil algæ in the cretaceous rocks of India, from the Niniyur group of the Trichinopoly District (S. India).* Following up this discovery, other rocks of the Trichinopoly cretaceous area were also looked into for algal remains, and it was seen that almost every one of these, especially the limestones, also showed more or less abundant algæ. Thus within the last few years we have been able to make a large collection of fossil algæ from these and certain other beds of South India. The entire material is being studied in detail by my colleagues Messrs. C. Prasannakumar, S. R. Narayana Rao and K. Sripada Rao; in the meanwhile, it is proposed in this article to give a general account of these algæ with special reference to a few forms of outstanding stratigraphical or palæobotanical importance.

Convincing algal structures were first noticed in sections of certain nodules occurring in the limestones of the Niniyur group, and very soon it was seen that the limestones themselves also contained plenty of algæ, some of the best algal remains being noticed in the flints and cherts which are the result of the silicification of these limestones.[2] These fossil algæ from the Niniyur group were studied in collaboration with Prof. Julius Pia of Vienna, the great authority on fossil algæ, and the results published as a memoir in the Pal. Indica series of the Geological Survey of India.[3] Among these algæ from the Niniyur division are represented the following groups: (*a*) the Rhodo-

* The cretaceous rocks of the Trichinopoly Dt., S. India, range in age from the cenomanian to the danian of the standard stratigraphical scale, and are divided into four groups. Starting from the oldest these are (*a*) the Utatur, (*b*) the Trichinopoly, (*c*) the Ariyalur, and (*d*) the Niniyur.

phyceæ, represented by the Solenoporaceæ and the Corallinaceæ, (*b*) the Chlorophyceæ, represented by the Dasycladaceæ, and (*c*) the Chætophoraceæ. Of the Solenoporaceæ represented in these rocks, we have *Parachætetes asvapatii*, a new species which is seen to build up small calcareous nodules composed of several more or less broad and blunt lobes, with the tissue indicating a fairly clear differentiation into a hypothallium and a perithallium. Of the Corallinaceæ, we have only the most primitive genus *Archæolithothamnium* (belonging to the subfamily Melobesieæ), the common species being *A. lugeoni*. This species had hitherto been known only from the eocene (of Spain) and its occurrence in South India in beds of cretaceous age is therefore remarkable. A form closely similar to *A. provinciale* is also commonly noticed. A careful comparative study of the different types of *Archæolithothamnium* noticed in the Niniyur rocks brings out the important fact "that the difference between perithallium and medullary hypothallium, between protuberances and branches, is not a fundamental one in *Archæolithothamnium*. This seems to be one of the primitive characters of the genus". The Dasycladaceæ, though present only in a few sections, are of special interest from the palæobotanical point of view. Here we have a new form *Dissocladella savitriæ* which is very well preserved, and is perhaps the most complete *Dissocladella* yet known, throwing an important light on the origin and inter-relationship of the Thyrsoporelleæ and the Triploporelleæ. We have also a new genus *Indopolia* which though closely resembling *Neomeris* in certain respects is still distinct in possessing two cortical cells and two sporangia on each primary branch. There is also a new species of *Acicularia*—*A. dyumatsenæ*, with club-shaped spicules about 2½ times as long as thick. The existence of such Aciculariæ with very stout spicules in the upper cretaceous is important in supporting the idea of a possible connection between this genus and *Terquemella*. It is in fact very likely that some of the Terquemellæ are really primitive ancestors of *Acicularia*. On the whole, it will be seen that the Niniyur fossils add considerably to our knowledge of cretaceous algæ, and will also no doubt be of great value in local stratigraphical correlation. For example, the writer recently noticed algæ similar to those of the Niniyur beds in a series of cherts and quartzites occurring near Vilangudi, about 9 miles to the south of the Niniyur area; and on this and other evidences, he has shown that these Vilangudi cherts and quartzites are the stratigraphical equivalents of some of the Niniyur beds further north and therefore are of the same age, thus leading to the conclusion that the post-senonian transgression of the sea which gave rise to the beds of the Niniyur division must have extended as far south as Vilangudi.

Another series of rocks in the Trichinopoly cretaceous area in which plenty of algæ have also been noticed are the 'coral reef limestones' at the base of the Utatur division. These limestones are of cenomanian age and thus older than the rocks of the Niniyur division which are danian. They occur in detached bands along the western and southern borders of the Utatur division, the most prominent of these being the one seen near the village of Cullygoody, about 9 miles south-east of Utatur. The work of Messrs. C. Prasannakumar and K. Sripada Rao has shown that in all these bands, the limestones reveal the presence of algæ in great abundance and there is no doubt that they have played quite an important part in the building up of these reef limestones.

Fossil algæ have also been discovered in some of the cretaceous limestones near Pondicherry.[4] The exact age of these Pondicherry limestones is uncertain, and all that we are sure of just now is that they come somewhere between the coral reef limestones and the Niniyur beds of the Trichinopoly area, *i.e.*, between the cenomanian and the danian. The Pondicherry algæ are therefore likely to be doubly important, first as providing a possible means of correlating these beds with those of the much better known Trichinopoly area, and secondly, as revealing a new field providing further material for our study of cretaceous algæ.

Another area where notable discoveries of fossil algæ have been recently made by my colleagues Messrs. S. R. Narayana Rao and K. Sripada Rao is near Rajahmundry, in the sedimentary inter-trappean beds of the Deccan trap, which was till recently considered as upper cretaceous in age. A brief account of these algæ has been just published[5,6]; and from this it will be seen that this algal flora is even more recent than that of the danian Niniyur strata and

has a decidedly modern character, as is evident from the occurrence of the living genus *Neomeris*, together with a type of *Acicularia* (with long needle-like calcareous spicules) which has never been noticed in strata older than paleocene. This lends further support to the view recently put forward on other considerations that the Deccan lower inter-trappean beds are at least paleocene in age—a point of great importance in discussing the age of the Deccan trap.[7,8,9] It is also very interesting to notice that side by side with these modern forms, we have in these beds the occurrence of *Holosporella siamensis*[10] a new form founded by Prof. Pia[11] from the Kamawkala limestone (upper triassic) on the Burmo-Siamese frontier. This is a very primitive member of the Dasycladaceæ, and if the upper triassic age of the Kamawkala limestone is certain, its survival into the tertiary as is indicated by its occurrence in the Rajahmundry area is indeed remarkable.

In addition to the above, quite an excellent collection of fossil Charophyta has also been made from these inter-trappean beds by Messrs. K. Sripada Rao and S. R. Narayana Rao. They have studied this material in great detail and have prepared an elaborate paper which will shortly be published as a memoir in the Pal. Indica series of the Geological Survey of India.[12] In this collection they have recognised as many as 13 species of *Chara*, of which 9 are of those already known, and the other 4 appear to be new. The above tabular statement (Table I) prepared by Messrs. K. Sripada Rao and S. R. Narayana Rao shows the stratigraphical distribution of the 9 species of *Chara* already known elsewhere, and now recognised in the Rajahmundry inter-traps.

TABLE I.

Name of species		Cretaceous	Paleocene	Eocene	Oligocene	Miocene
C. wrightii, Salter ..	..	..	..	*	..	..
C. helicteres, Brong. ..	..	..	*	*	*	*
C. medicaginula, Brong.	..	..	..	*	*	*
C. caelata, Reid & Groves.	..	..	..	*	..	..
C. vasiformis ,,	..	..	..	*	*	..
C. turbinata ,,	..	..	..	*	..	..
C. strobilocarpa ,,	..	..	..	*	..	..
C. subglobosa, Groves.	..	..	..	..	*	..
C. oehlerti, Dollfus. ..	..	..	..	..	*	..

* Indicates that the species is represented.

One striking and important fact which emerges from the above is that all the known species of *Chara* in this collection are exclusively tertiary forms, thus once again indicating at least a lower tertiary age for the inter-trappean beds which contain them.

From the foregoing account, it will be seen that a very rich and varied algal flora has been discovered in the cretaceous and early tertiary beds of South India, the study of which will no doubt lead to conclusions of great interest and importance regarding the origin, evolution, and distribution of cretaceous and early tertiary algæ in general.

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The Fossil Galleries of the Indian Museum.

History and Recent Improvements.

By Dr. M. R. Sahni, M.A. (Cantab.), Ph.D., D.Sc. (Lond.), D.I.C.
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Introduction.

SINCE the publication of the report on "Museums in India", and the recent Museums' Conference held as a result of it, public attention has been focussed on the various aspects of improvements of the museums in this country. It has been recognised that a museum, in addition to its scientific value, should serve an important educative function and therefore it must possess a high popular appeal. A museum should, in fact, be not merely a repository of the nation's art or natural history treasures or its archæological wealth, but it should constitute what has been aptly termed a "University for the masses".

For this purpose it is essential, as was properly emphasised by the Museums' Conference, that museum collections should be divided into reserve study collections, for advanced research, and display collections, for the benefit of the lay public. It is with this object in view that the Fossil Galleries in the Indian Museum, which belong to the Geological Survey of India, are being reorganised and various improvements have recently been effected therein.

Historical Review.

Before giving an account of the popular improvements recently initiated in the Fossil Galleries of the Indian Museum, a brief review of their origin and growth, which are intimately connected with the origin of the Geological Survey of India, may be of some interest.[1]

Over a century ago (about 1817) the Government of India realised the importance of obtaining coal supplies from India for the steamers navigating the Ganges and other rivers. Later, in 1836, a "Coal Committee" was appointed during the time of Lord Auckland, which continued to function till 1845, when they recommended to the Government of India the formation of a "Geological Survey of the Coal Formations of India". This recommendation was given effect to and in the same year an officer of the Geological Survey of Great Britain was sent as Geological Surveyor to the East India Company. The first official report of the Geological Survey of India was submitted for 1848–49.

Although the Geological Survey of India may be said to have been established in 1845,[2] it had no permanent office till many years later and of course there was no Museum. But certain collections that had been made earlier were deposited at the premises of the Asiatic Society of Bengal in 1835. Previously to this, the Asiatic Society (founded in 1784) had considered (1796) the formation of a Museum. The outcome was that an important collection offered by Dr. Wallich to the Society in 1814 was amalgamated with the 1835 collection, and in 1840 the Government of India appointed a Curator to look after it.

This collection, then, formed the nucleus of the collections that now find a place in the Fossil and Economic Galleries of the Indian Museum. Before, however, these collections were lodged in their present abode, they underwent a number of vicissitudes, having been transferred first from the Asiatic Society's Office to 1, Hastings Street (1856), then from there to the Indian Museum, 27, Chowringhee (1876). A third transfer of part of the collection took place in 1896 to the present Offices of the Geological Survey of India.

During the past ninety years or so the collections in our Fossil Galleries have been supplemented by exchange and presentations from foreign museums, as well as by the specimens collected by the officers of the Geological Survey Department, so that we have now one of the finest collections in the world.

The Fossil Galleries of the Indian Museum are divided into two sections, the Invertebrate Gallery and the Siwalik Gallery, the latter containing mostly Tertiary and Pleistocene vertebrate fossils. The name

[1] A more detailed history of the Geological Survey of India and its Museum is given by Dr. C. S. Fox in *Trans. Min. Geol. Inst.*, 1936, **36**, 13–37.

[2] This date has now been officially accepted.

Siwalik Gallery is perhaps a misnomer, for it contains not only the priceless fossil vertebrates from the Siwalik formation of India, but also many foreign Tertiary species. This has been inevitable on account of the shortage of space. But it is the ultimate aim of the reorganisation scheme now in hand to make the Siwalik Gallery representative of the Siwalik vertebrate fossils only, and to transfer the other fossils to a Foreign Vertebrate Gallery, when more space is available. Likewise the few vertebrates now shown in the Invertebrate Gallery, owing to want of space, will be transferred either to the Siwalik Gallery or to the proposed Foreign Vertebrate Section.

Recent Improvements.

Pictorial Exhibits.

To the average person the skeletal remains of animals exhibited in the show cases do not convey much. They are to him merely dead bones without any understandable relation to the interesting and often awe-inspiring forms of extinct life that once clothed them. The absence of pictorial restorations was therefore keenly felt. This deficiency has to a certain extent been remedied, for enlarged restorations of some of the more important Indian and foreign fossil genera have been prepared from authoritative works and are now exhibited in the Siwalik Gallery (Fig. 1). On account of their popular appeal these have attracted considerable attention.

Notable among these are the serial wash drawings illustrating various stages in the evolutionary history of the elephant and the horse (Fig. 2, top, right). Such facts that the earliest known elephant, the *Moeritherium*, looked more like a pig than like its modern representative, that extinct forms like *Tetrabelodon* possessed four instead of two tusks, while the African species *Loxodonta africana* possessed four tusks in its upper jaw alone, are better appreciated by drawings than from actual specimens, which are generally imperfectly preserved.

Similarly, pictorial restorations showing that the *Platybelodons* possessed shovel-shaped lower jaws, that *Stegodon ganesha* from the Siwalik formation is one of the giant predecessors of the living Indian elephant, that some of these extinct elephants probably represent successive stages in the evolutionary history of the Proboscideans, better illustrate the family history of the

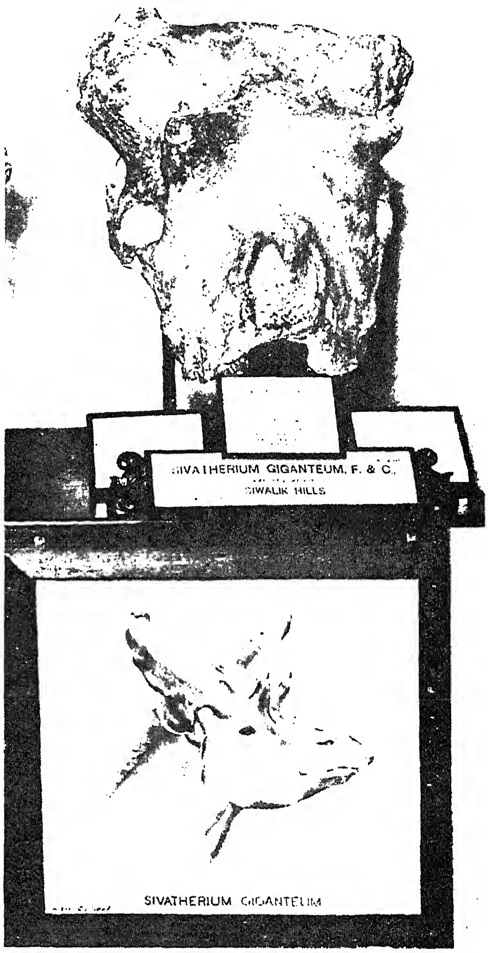

Fig. 1. Restoration of interesting extinct Indian fossil species (Giraffidæ) after Colbert.

race than disjointed portions of fossil jaws and bones.

The various genera of the fossil horse of America, *Eohippus* (four-toed horse), *Mesohippus* (three-toed horse), *Merychippus* (three-toed horse with the middle toe stronger than in *Mesohippus*), the Indian three-toed fossil horse, *Hipparion*, and the modern horse, *Equus*, are similarly illustrated.

Other pictorial restorations of the more important and interesting forms are under preparation and will be exhibited in due course.

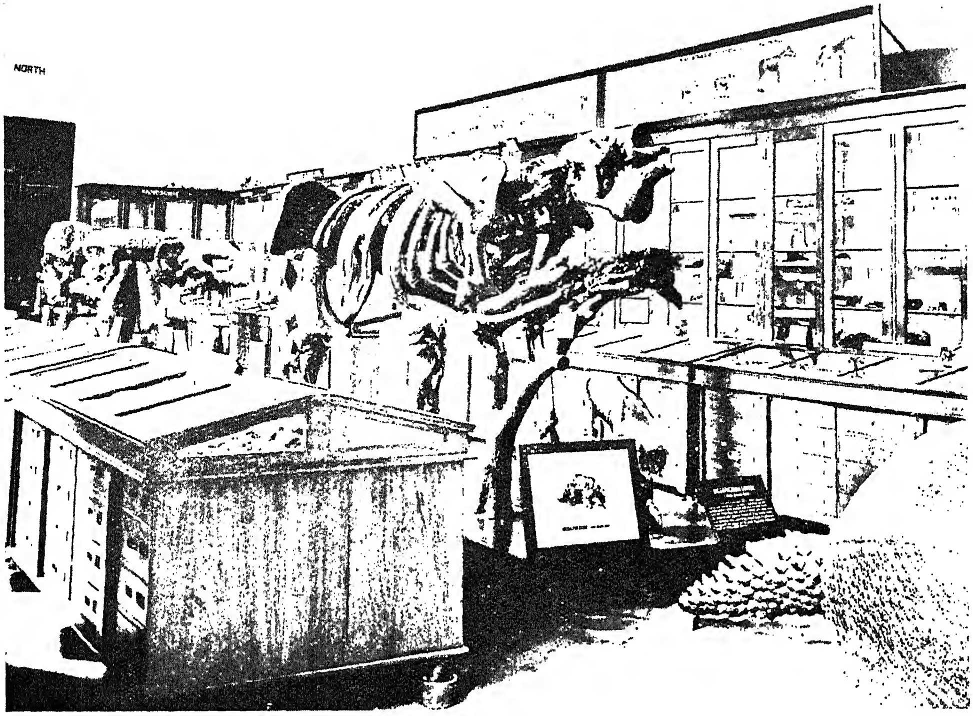

Fig. 2. A general view of the Siwalik Gallery after rearrangement.

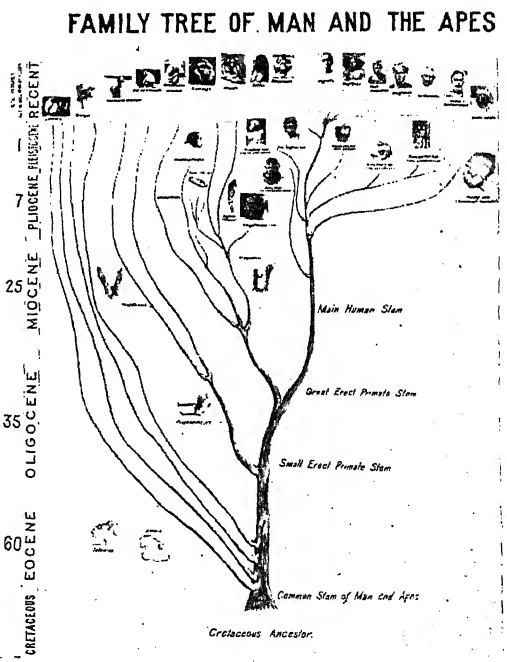

Fig. 3. A recent addition to the Siwalik Gallery.

Genealogical Tree of Man and the Apes.

Another exhibit in the Siwalik Gallery which has created general interest is a pictorial chart by the writer in the form of a 'tree' showing the evolution of the human race and of our near relatives, the apes (Fig. 3). An attempt has been made to show at a glance the origin and probable relationship of the various fossil men—*Pithecanthropus erectus* (Java ape man), *Eoanthropus dawsoni* (Piltdown man), *Sinanthropus pekinensis* (Peking man), *Homo heidelbergensis* (Heidelberg man), *Homo neanderthalensis* (Neanderthal man), etc., as well as their relative antiquity, as compared with our own species—*Homo sapiens*. The 'tree' brings out further the relationship not only between the different ape lineages—the Lemurs, the Tarsiers, the New and Old World monkeys and the tail-less or Anthropoid apes, like the Gibbons, Chimpanzees, Gorillas, etc., but also their relationship with modern man and his early progenitors.

Almost the first question that a visitor asks about a fossil exhibit is its age. The

probable ages of the geological periods in which the fossil men and apes occur, are therefore given in a separate column. It is explained that man, the most highly evolved of the Primates, is only about a million years old, and that his antiquity compared with the 500,000,000 years or more that have elapsed since the dawn of life upon the earth is but a fleeting moment.

Descriptive Labels in the Indian Languages.

It is obvious that if the exhibits are to be understandable to the lay public they should be explained by descriptive labels in the languages which they read.

In the case of the provincial museums, where the extraneous element in the population is negligible, descriptive accounts in the language of the province and in English would generally be adequate. In the case of a large cosmopolitan city like Calcutta, however, the linguistic problem is naturally an important one. Experience has shown that Hindi, Bengali and Urdu are the three languages which are most useful. Descriptive labels have accordingly been prepared in these languages. In addition to the shorter labels for individual exhibits or fossil groups a generalised account of the exhibits in the Siwalik Gallery, dealing with the evolution, distribution and migration of the Tertiary vertebrates and with the geography of the Siwalik period has also been added. This label gives, in fact, a bird's-eye view of the history of the Siwalik period and of its fauna.

It is refreshing to find groups of semiliterate visitors, endeavouring to decipher the labels in the language which they understand and explaining them to their fellows, whereas formerly most of the fossil exhibits were a puzzle to them. Judging by the spontaneous interest that it has evoked, the introduction of descriptive labels in the Indian languages is perhaps the most important and necessary item of the various improvements effected.

Guide-Books.

At present there is no satisfactory guide-book for the Fossil Galleries. The existing guide-book of the Indian Museum is far too generalised to be of much use to the average man, for none of the exhibits are adequately explained.

In order to meet this serious deficiency a short guide to the Siwalik Gallery is under preparation but it will deal mostly with the larger or more interesting specimens and is not to be considered as a detailed guide. It is proposed, when more space is available, that exhibits and show cases should undergo further rearrangement, and the preparation of a detailed guide-book at this stage would therefore mean duplication of work. The guide-book now being completed will in due course be translated into the Indian languages, like the other descriptive accounts of the Siwalik exhibits, and will be, it is hoped, of much use to the general public.

The Invertebrate Gallery.

The exhibits in the Invertebrate Gallery are, for obvious reasons, less spectacular from the point of view of the general public than those in the Siwalik Gallery. Yet much can be done in the way of illustrating progressive stages of evolution in different genera or groups, for which invertebrate species, owing to their prolific occurrence, are most suited. One such series, illustrating the evolution of the Cephalopods has now been exhibited. The *Saligrams* sacred to the Hindus, a specimen of which is exhibited with the evolutionary series, contain specimens of the highly coiled ammonites (Cephalopods) in their cores. They are in fact clay nodules containing an ammonite shell as a nucleus.

Mention need hardly be made of the rearrangement, card-indexing, etc., now in hand, of our fossil collections, to facilitate exchange, presentations and palæontological research.

Finally, it is hoped that when more space is available and financial conditions permit the fine collections of fossils from different regions like Kashmir, Spiti, the Salt Range, South India, etc., will be suitably exhibited in separate sections. This will help to bring out comparisons between the stratigraphy and palæontology of different regions of India, and will constitute a valuable improvement. In respect of wealth of material our Siwalik and Invertebrate Galleries compare very favourably with the greatest museums in the world.

Khan Bahadur Mian Mohammad Afzal Husain, M.A. (Cantab.), M.Sc., F.N.I.

WE have much pleasure in congratulating Khan Bahadur Mian Mohammad Afzal Husain, Principal, the Punjab Agricultural College, Lyallpur, on his appointment as Vice-Chancellor, the Punjab University.

Khan Bahadur Mian Afzal Husain, who belongs to a well-known family of Batala, Gurdaspur District, Punjab, had a distinguished university career both in the Punjab and at Cambridge. He was the recipient of the Alfred Patiala Research Scholarship of the Punjab University from 1911 to 1913. In the year 1913, he proceeded for higher studies to Cambridge, where he was elected a Foundation Scholar of the Christ's College in 1914 and a Bachelor Scholar in 1916. He won the Frank Smart Prize for Zoology in 1916 and the Charles Darwin Prize for original research work in 1918.

Dr. Afzal Husain.

In 1918, he was selected by the Secretary of State for India for the Indian Agricultural Service and posted as Supernumerary Entomologist at the Imperial Agricultural Research Institute, Pusa. In 1919, he was appointed as the Entomologist to the Government of the Punjab at the Punjab Agricultural College and Research Institute, Lyallpur, which he held with distinction till 1930, except for a short break in 1925, when he officiated as Imperial Entomologist at Pusa. In December 1930, he was placed in charge of the scheme of Locust Research then started by the Imperial Council of Agricultural Research under the designation of Locust Research Entomologist with headquarters at Lyallpur. In April 1933 he reverted to the Punjab Government to take up the duties of the Principal, Punjab Agricultural College, as well as of the Government Entomologist. He is a Fellow of the Punjab University, and has been a member of the Syndicate since 1936.

As an Entomologist, he has been responsible for the sustained development of the Entomological Section of the Institute to its present state of high efficiency from the point of view of both economic work and teaching. He is the author of a number of publications relating to various insect pests of the Punjab. He has also published several papers of high scientific value on the bionomics of the Desert Locust, research work on which he has been continuing with the aid of a research grant of the Imperial Council of Agricultural Research, New Delhi, even after relinquishing charge of Locust Research work in 1933.

In his capacity as Principal of an important college and as a Fellow and Member of the Syndicate of the Punjab University, Khan Bahadur Afzal Husain has rendered conspicuous service to the cause of higher education both in the technological and literary fields. He is now summoned to occupy the highest post, which it is in the gift of the University to offer, and it is hoped that the knowledge and experience which have accrued to him will be of inestimable value in directing the destiny of one of the most important educational institutions in India, distinguished alike as an accomplished centre of scientific researches and of formal learning.

We wish Khan Bahadur Afzal Husain every species of success in his exalted sphere of work.

Mr. D. N. Wadia.

MR. D. N. WADIA, who has just retired after a distinguished service in the Geological Survey of India, proceeds to join his new appointment in Ceylon towards the end of this month. The extensive knowledge and experience of Mr. D. N. Wadia which he has patiently accumulated during his scientific career in India, will be of inestimable value in his exploratory work in Ceylon which presents a virgin field for investigations. The Geology of this southern island must present the most fascinating problems, and we look forward to the report which Mr. Wadia will draw up on the conclusion of his field researches.

Mr. D. N. Wadia.

We wish Mr. Wadia success in his new sphere of activity for which he brings a fresh outlook.

Nursing Profession.

AMONG the proposals contained in the Madras Government Communique, recognising this branch of the medical service, suggestion is made that men nurses, as they become available, should be employed in the male wards in the future. As an administrative scheme, this is unimpeachable. But as a service expedient it is undoubtedly a daring experiment. The long and exclusive association of women with this important profession had led grammarians to treat the word "nurse" as a feminine gender. We consider that nursing is part of suckling. The whole problem is essentially biological. Is man physically and emotionally fit for this delicate and fundamentally soft profession? Will he not threaten the patients with dire consequences if they refuse to swallow medicine and nutriment? Does he know how to smile and coax the refractory patients? Can he caress them with becoming feelings of sympathy? We think that man as a nurse must be a new type of *Homo*, who must first learn how to suckle and bring up the new born young babies, before he can be a sweet and smiling angel. If man had the innate gifts surely Scott would not have written his famous apostrophe to woman :

"O Woman! in our hours of ease,
Uncertain, coy and hard to please,
And variable as the shade
By the light quivering aspen made,
But when pain and anguish wring the brow,
A ministering angel thou—"

LETTERS TO THE EDITOR.

Variation in the Composition of the Pigments of Indian Cotton Flowers.

With a view to obtain more of the new compounds Herbacitrin and Gossypin for purposes of further study we had occasion to examine different batches of Herbaceum and Indicum flowers that were obtained during different seasons and from different localities. The composition of the pigments was found to vary from sample to sample. For example, one of the early batches of Herbaceum (Coimbatore, 1933) yielded sufficient amount of Herbacitrin to enable us to study most of its reactions and establish its constitution.[1,2] Subsequent collections did not yield any appreciable amount of this substance. Last summer we obtained a sample from the Bellary District (Hagari A.R.S.) which approximated closely to the earlier Coimbatore sample and it gave us a satisfactory yield of Herbacitrin. The complex glucoside Gossypin was originally isolated from the Indicum flowers collected in Coimbatore in 1933.[3] A large quantity of these flowers from the same place obtained in 1937 gave no Gossypin at all. All the Gossypetin was present in the form of Gossypitrin and further a good amount of Herbacitrin could be isolated. It has been our experience that the Indicum flowers contain no free aglucones whereas the Herbaceum invariably yields free Quercetin. It should however be stated that when expressed in terms of the non-glucosidic bodies the flowers contain the same flavonols in more or less quantities. The variations arise when the glucosides are taken into consideration.

For quick diagnosis of the various fractions of the pigments, colour reactions with alkaline buffer solutions have been very serviceable. Of particular use is the solution with pH 9·8. Herbacitrin and Gossypitrin give emerald green shades after a preliminary yellow whereas Gossypin and Quercimeritrin yield pure yellow which does not change. Gossypetin and Herbacetin give pure blue after preliminary yellow whereas Quercetin produces only yellow which does not change. Quick distinction between the glucosides Herbacitrin and Gossypitrin is rather difficult since they are very similar in properties. However the hydrate of Gossypitrin usually exhibits a marked sintering at about 203° and this gives a reliable indication. Herbacitrin does not show any sintering at this temperature. After hydrolysis the aglucones, Gossypetin and Herbacetin have different melting points though their reactions are very similar.

Here again there may be difficulty in deciding between a pure sample of Herbacetin and an impure one of Gossypetin whose melting point will consequently be lower. We have now discovered one easy distinction between the two flavonols. When a solution of each in absolute alcohol is treated with a small quantity of one per cent. sodium amalgam (Bargellini's reaction),[4] Herbacetin gives a green flocculent precipitate whereas Gossypetin yields a brown one. The production of greenish flocks in this reaction has been taken to be characteristic of flavonols and flavones having three vicinal hydroxyl groups in the benzopyrone nucleus as in Baicalein, Scutallerein[4] and Quercetagetin[5] (positions 5, 6 and 7). Herbacetin which has a different disposition of the hydroxyl groups (5, 7 and 8) should also be considered as giving a positive reaction though the precipitate after it settles down is bluish green. At the beginning it gives the same green precipitate as described for Quercetagetin, Baicalein and Scutallerein. It is, therefore, not safe to consider Bargellini's reaction as a sure indication of the constitution. It however offers a definite and easy means of distinguishing between Gossypetin and Herbacetin.

P. Suryaprakasa Rao.
T. R. Seshadri.

Department of Chemistry,
Andhra University,
Waltair,
October 20, 1938.

1 Neelakantam, Seshadri and Rao, *Proc. Ind. Acad. Sci.*, (A), 1935, 2, 494.
2 Neelakantam and Seshadri, *ibid.*, (A), 1937, 5, 357.
3 ,, ,, *ibid.*, (A), 1936, 4, 54.
4 Bargellini, *Gazetta*, 1919, 49, ii, 47.
5 Baker, Nodzu and Robinson, *J.C.S.*, 1929, p. 74.

Adsorption of Methylene Blue by Active Carbon.

The adsorption of methylene blue by four samples of active charcoal was studied in solutions of varying pH. The results with blood charcoal containing 1·85% ash, may be taken as typical and were as follows :

Initial pH	Equilibrium pH	Dye adsorbed per gram of charcoal mg.
2·26	2·10	300
2·39	2·46	290
2·94	2·06	270
6·15	3·75	262
6·80	3·97	350
7·32	4·10	390
8·66	7·02	430

The increased adsorption beyond the equilibrium pH 3·75 could be accounted for by the enhanced negative charge on the carbon due to greater adsorption of hydroxyl ions from solution, and the opposite effect observed below pH 3·75 was found to be due to adsorption of chlorine ions from the hydrochloric acid which was added to increase the acidity of the solution. The pH region, 3·75 to 3·97, in which a sharp rise in adsorption was observed could be identified with "the isoelectric zone", for it is in this region, probably, that a reversal of the charge on the carbon takes place.

The fall in pH is obviously due to liberation of hydrochloric acid. The rate of fall of pH during the progress of adsorption of methylene blue on blood charcoal was ascertained by successive pH measurements. Assuming that adsorption of each molecule of basic dye causes the liberation of one molecule of acid, a computation was made of the rate of adsorption. The values so calculated were found to lie on a curve which ran closely parallel to the one that was obtained from the results of the experiments. This confirms the view expressed by Bartell and Miller[1] that the liberation of acid or base accompanies adsorption of electrolytes.

The author thanks Dr. K. R. Krishnaswami, D.Sc., F.I.C., for his kind interest and valuable guidance in the investigation.

M. V. C. Sastri.

Department of General Chemistry,
Indian Institute of Science,
Bangalore,
November 4, 1938.

1 *J. Amer. Chem. Soc.*, 1922, 44, 1866.

Effect of Treatment on the Hygroscopic Capacity of Soils.

THE fertility of a soil has long been associated with its power to absorb moisture from the air. The hygroscopic coefficient, as a soil characteristic which is connected with other physical properties of the soil, is of great interest in physical studies. The black cotton soils of Bellary are noted for their high powers of absorption. In the following note the effects of alternately heating and wetting the soil and of ignition on the hygroscopic capacity are discussed.

1. *Alternate Heating and Wetting.*—During studies on the hygroscopic capacity of soils it was found that the surface soil usually showed a lower capacity for absorption of water vapour than samples of soil taken from lower layers. An examination of the mechanical composition and other physical properties of the different layers of the profile at Hagari[1] showed that the soil is fairly uniform to a depth of three feet. The observed differences in the hygroscopic capacity of the different layers could not also be explained by the differences in the SiO_2/R_2O_3 ratios[2] for the different layers. The decrease in the hygroscopic capacity of the surface soil was naturally thought to be due to the fluctuations in the weather conditions which directly influence the top soil, which is subjected more frequently to alternate heating and wetting than the lower layers. In order to establish this, samples of black cotton soil of Hagari taken from different depths were alternately saturated with water, air dried for two days and dried in a steam oven overnight. This treatment was repeated five times. The hygroscopic capacity at 100, 99 and 75% relative humidities was studied for the treated and untreated samples under the same conditions of temperature. The vacuum desiccator method which was reported to be very satisfactory by other workers,[3] was used. The following results were obtained before and after treatment for the different relative humidities (Table I).

TABLE I.

Hygroscopic absorption.

(Period of exposure : 5 days.)

Depth	R.H.						Ratio :	
	100%		99%		75%		100/75%	
	A	B	A	B	A	B	A	B
0—6″	14·78	13·39	14·07	13·70	8·52	7·89	1·74	1·69
6–12″	15·73	13·90	15·27	14·11	9·29	8·28	1·69	1·68
12–18″	16·03	13·85	15·33	14·17	9·38	8·23	1·75	1·68

(*A*–before treatment: *B*–after treatment. The figures in this and the next table are the averages of duplicates which agreed among themselves.)

There is a decrease in the hygroscopic capacities at each of the relative humidities at which the experiment was done. The ratio of the hygroscopic absorption at 100% R.H. to that at 75% R.H. remains practically unaltered. The results emphasise the necessity, while dealing with hygroscopic capacities of soils, for defining not only the period of exposure, but the layer from which the soil sample is obtained.

2. *Ignition on Hygroscopic Moisture.*—The effect of igniting the soil in an open flame for 24 hours on the hygroscopic capacity was studied for soils obtained from different places. The ignited and unignited samples of soil were exposed to the same conditions of temperature and humidity for 24 hours. The following table contains the values for the hygroscopic coefficient (100% R.H.) for the ignited and unignited samples.

TABLE II.

	Soil	Depth	Hygroscopic coefficient		
			Before ignition	After ignition	Decrease
Black Soils	Hagari ..	0–1′	10·47	2·49	7·98
	Nandyal ..	0–1′	11·85	3·84	8·01
	Jammalamadugu	0–1′	6·68	2·23	4·45
	Ambavaram ..	0–1′	6·98	2·13	4·85
	Koilpatti ..	0–1′	15·50	4·03	11·47
	Coimbatore ..	0–6″	8·69	3·79	4·90
Red Soils	Ananthapur ..	0–4″	1·45	0·65	0·80
	Kadiri ..	0–5″	1·96	1·11	0·85
	Nandyal ..	0–1′	8·61	4·13	4·48
	Anakapalli ..	0–1′	4·47	2·31	2·16
	Koilpatti ..	0–9″	6·58	2·40	4·18

It is clear that after ignition the black soils which are 'heavy' retained from 20 to 45% of the original capacity for absorption while the red soils retained about 35 to 55% of the absorption capacity. On ignition, the hygroscopic coefficient of soils, though greatly reduced, is by no means negligible in relation to the original value. The results are in agreement with those reported by Puri, Keen and Crowther[4] and by Alway[5] for other types of soils.

A. S. Rao.
A. Abdul Samad.

Dry Farming Station,
Bellary,
September 27, 1938.

[1] *Report of the Madras Dry Farming Scheme*, Hagari, 1936–37, p. 20, of the *Report of the Soil Physicist*, *I.C.A.R.*
[2] Report of the Madras Dry Farming Scheme, Hagari, 1935–36, *I.C.A.R.*, p. 34.
[3] Puri, A. N., Crowther, E. W., and Keen, B. A., *Jour. Agri. Sci.*, 1925, **15**, 68.
[4] —, *loc. cit.*
[5] Alway, F. J., *Colloid Symposium*, 1925, **III**, 241.

Humic Acid as a Photocatalyst in Photoammonification.

In recent years Gopala Rao and Dhar,[1] Gopala Rao,[2] Gopala Rao and Pandalai,[3] have brought forward evidence to show that nitrification and ammonification in soils are not entirely due to the action of bacteria but can also be brought about at the surface of suitable catalysts under the influence of light. Corbet[4] has confirmed the results of these investigators. Zobell[5] has also shown that nitrification in sea-water cannot be due to bacterial action. By taking some solutions of ammonium salts and exposing them to sunlight with sea-water and magnesium carbonate he found that oxidation of ammonia to nitrite occurs. Fraps and Sterges[6] have, however, expressed some doubt regarding the validity of the photochemical view. Sarkaria and Fazal-Uddin[7] observed that sodium nitrite is oxidized to nitrate in the presence of zinc oxide and sunlight. Dhar and co-workers[8] also noticed oxidation of nitrite in dilute solution when exposed to sunlight in the presence of zinc oxide or ferric oxide. Gopala Rao and Murty[9] have investigated the photodecomposition of nitrate to nitrite; they have found that this occurs as a reversible reaction in sunlight transmitted by glass in the presence of ferric oxide or sterilized red soil. Moreover, they have made the very interesting observation that during the photodissociation of nitrate, any ammonium salt present will undergo simultaneous oxidation to nitrite.

It thus appears that many reactions hitherto ascribed to bacteria in the soil can also be brought about by sunlight with soil as a photocatalyst. In this note we are reporting the results obtained on the photo-ammonification of amino-acids in sunlight in the presence of humic acid. The humic acid employed was extracted from black garden soil with 5 per cent. sodium hydroxide solution and precipitated from the latter by the addition of warm 1:1 hydrochloric acid. 250 c.c. of M/20 solution of the appropriate amino-acid was shaken up with 0·25 gm. of humic acid and exposed to sunlight in a pyrex glass flask under strictly aseptic conditions.

The amount of ammonia formed was estimated by the Folin aeration method from time to time.

Amino acid	Amount of ammoniacal nitrogen formed in mg. per litre	
	60 hours	120 hours
Alanine	32·42	64·21
Aspartic acid	21·23	42·34
Glutamic acid	21·26	42·42

It is thus evident that humic acid can function as a catalyst in the photo-chemical decomposition of amino-acids in sunlight.

G. Gopala Rao.
T. S. Narayana.

Department of Chemistry,
Andhra University,
Waltair,
September 15, 1938.

[1] Gopala Rao, G., and Dhar, N. R., *Soil Science*, 1931, **31**, 379.
[2] Gopala Rao, G., *ibid.*, 1934, **38**, 143; *Jour. Ind. Chem. Society*, 1934, **11**, 617.
[3] Gopala Rao, G., and Pandalai, K. M., *Jour. Ind. Chem. Society*, 1934, **11**, 623.
[4] Corbet, A. S., *Biochem. J.*, 1934, **28**, 1575; *ibid.*, 1935, **29**, 1086.
[5] Zobell, C. E., *Science*, 1933, **77**, 27.
[6] Fraps and Sterges, *Soil Science*, 1935, **39**, 85.
[7] Sarkaria and Fazal-Uddin, *Ind. Jour. Agri. Sci.*, 1933, **3**, 1057.
[8] Dhar, *et al.*, *Nature*, 1934, **10**, 213; *Jour. Ind. Chem. Soc.*, 1936, **13**, 180.
[9] Gopala Rao and Murty, K. S., *Proc. Nat. Inst. Sci.* (India), 1937, **3**, 133.

Photosensitisation by Stannic Oxide.

PHOTOSENSITISATION by zinc oxide and titanium dioxide has been studied by numerous workers. These oxides absorb in the near ultraviolet and photosensitise various chemical reactions. A. Eibner[1] studied the decolorisation of various dyes in the presence of zinc oxide and light. Winther[2] observed the formation of hydrogen peroxide when water was exposed in a glass vessel in the presence of zinc oxide. E. Baur and co-workers[3] studied the decomposition of aqueous solutions of silver nitrate in sunlight photosensitised by zinc oxide. C. Renz[4] observed that titanium dioxide becomes markedly photosensitive in the presence of certain organic liquids and reducing solutions, particularly glycerol. Gopala Rao[5] studied the photosensitised oxidation of aqueous ammonia in sunlight with titanium dioxide and zinc oxide as photo-sensitisers. He has also observed that the oxidative de-amination of various amino-acids in sunlight is markedly accelerated by these photo-sensitisers. Goodeve and Kitchener[6] studied the photosensitised decolorisation of wool violet by titanium dioxide. Photosensitisation by solids is of great practical and theoretical interest. We have now observed that stannic oxide exhibits marked photosensitive action in the oxidation of aqueous ammonia and the reduction of potassium nitrate, in sunlight. Colloidal hydrous stannic oxide as well as the ignited oxide act as photo-sensitisers, though the latter is somewhat more active. Ammonia is oxidized to nitrate and potassium nitrate is reduced to nitrite.

Some of the results are given below :—

A. 200 c.c. of N/2 solution of ammonia + 0·25 gm. of SnO_2 + 50 c.c. water.
B. 200 c.c. of N/2 solution of ammonia + 50 c.c. of 0·5 per cent. SnO_2 solution.

Hours of exposure to sunlight in pyrex-glass flasks	Nitrite nitrogen mg. per litre	
	A	B
8	1·076	0·677
16	2·333	1·458
25	2·918	1·945
35	3·676	2·363
53	4·568	3·061

It is evident from the above table that ammonia in aqueous solution is oxidised to nitrite in the light transmitted by glass. In the absence of stannic oxide or other photo-sensitisers the oxidation occurs only in the extreme ultraviolet.

It is well known from the work of Warburg that potassium nitrite decomposes to nitrite in ultraviolet light of wavelength shorter than 3000 Å. Now we have found that nitrate reduction can occur in light transmitted by glass in the presence of stannic oxide.

A. 200 c.c. of M/10 KNO_3 solution + 0·25 gm. of SnO_2 + 50 c.c. water.

B. 200 c.c. of M/10 KNO_3 solution + 50 c.c. of 0·5 per cent. SnO_2 sol.

Hours of exposure to sunlight	Nitrite nitrogen mg. per litre	
	A	B
10	1·199	1·090
27	2·567	2·333

We have also observed that the decolorisation of various dyes, *e.g.*, methyl violet, methylene blue, brilliant green, is also photosensitised by stannic oxide.

Further work is in progress.

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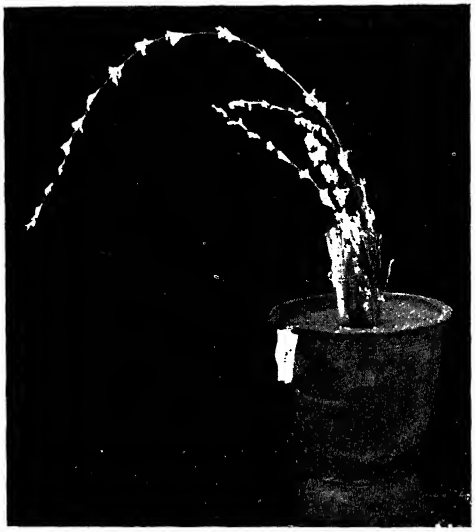
Department of Chemistry,
Andhra University,
Waltair,
October 7, 1938.

[1] *Chemiker Zeitung*, 1911, 755, 774, 786.
[2] *Z. Wiss. Phot.*, 1921, **21**, 141, 168, 175.
[3] E. Baur, *Helv. Chim. Acta*, 1918, **1**, 186; E. Baur and C. Nevweiler, *ibid.*, 1927, **10**, 901.
[4] *Ibid.*, 1921, **4**, 961.
[5] *Soil Science*, 1934, **38**, 143; *J. Ind. Chem. Soc.*, 1934, **11**, 617, 623.
[6] *Trans. Farad. Society*, 1938, **34**, 570.

Technique of Sugarcane × Bamboo Pollination.

One of the difficulties experienced in hybridizing the Sugarcane with the Bamboo has been the geographical distance between the bamboos in flower—often inside heavy and not easily accessible forests—and the parents at the Coimbatore Sugarcane Station. Such distances often involve a night's journey by train to Coimbatore, besides other foot track and road journeys.

This difficulty has recently been got over by a simple technique which makes fresh bamboo pollen available at the Sugarcane Station itself for cross-pollination purposes. When a bamboo clump flowers, individual bamboos are generally cut to ground level and utilized, as such clumps generally die



after the flowering. The stumps left in the ground produce, under favourable conditions, a profusion of shoots most of which develop into inflorescence. If such stumps are collected and planted in another place after careful transportation, they put forth inflorescences at the latter place and that too for fairly continuous periods, in some cases as long as three months. The photograph shows one of these flowerings at the Coimbatore Sugarcane Station, after transport from Madras.

Dr. Agnes Arber[1] records this characteristic of the bamboo and considers "that when a bamboo approaches the flowering phase its whole constitution is profoundly modified." The success of the present technique results from such modification.

S. A. Hussainy.

Imperial Sugarcane Station,
Coimbatore,
October 18, 1938.

[1] Agnes Arber, *The Gramineæ*, 1934, p. 99.

The Origin and Elimination of the Mass of Opaque Globules Bathing the Internal Organs of Aphids.

The greater portion of the body cavity of Aphids is occupied by the delicate internal organs, bathed as it were, in a mass of oily-looking opaque globules of a yellow or brown colouration. It appears at first sight that the presence of the globules is due to the action of secretory glands of some kind. Morren[1] (1836) suspected the presence of secretory glands at the base of the cornicles. Buckton[1] (1875) first made attempts to locate such glands and failed. The writer has repeatedly searched for the suspected glands, employing various means but by no means did the search prove fruitful. The hypothesis of secreting glandular structures as the source of the globules is untenable.

Further observations made in this connection lend support to the view that the processes involved in the origin of the globules, are purely metabolic in nature. The metabolic changes occurring in aphids result in two groups of residual end products; one consisting of excess of simple sugars and the other, of certain complex excretory bye-products. Whereas the former leave the digestive tract through the rectum and the anal opening, as the well-known "honey-dew", the latter, exerting great pressure on the walls of the tract, are diffused into the surrounding hæmocele, where they remain in the form of globules in the hæmocelic fluid, which is the so-called blood of aphids, as in all insects, generally. It is these globules that appear to be copious in the internal body spaces, bathing the internal organs.

The reason why these globules of an excretory nature occupy this situation and are not eliminated through the rectum, has

not been hitherto explained. The reason is to be found in the fact that the malpighian tubules which extract harmful residual products of digestion in solution in the blood, in insects, are entirely absent in aphids. The elimination of the globules from the body, however, is carried out in a simple manner by the tubular cornicles opening into the hæmocele of Aphids in the abdominal region where the globules abound. It is a matter of common observation, that, periodically, as the density increases, tiny masses of viscous matter appear at the open tips of the cornicles and are then forced out. Mechanically, too, very small quantities of the globules can be obtained by the application of slight lateral pressure on the abdominal wall. The injurious nature of the globules can be simply demonstrated by blocking the mouths of the cornicles with glue, when, gradually, the insects become sluggish, swell up and die away, turning semicrystalline. The cornicles which are peculiar only to the group Aphidæ in the insect world, are to be regarded as the only outward passages for a periodical elimination of harmful excretory products of metabolism, in the absence of malpighian tubules.

At least one of the constituents of the opaque globules was first made out by Muller as Salicin. The writer has, in several cases, confirmed this by digesting various species of aphids in chloroform and benzene, when the globules, forced out of the cornicles, left on the watch glass, after the evaporation of the liquid, numerous radiating silky needle-like crystals which turned vivid red on being touched with a drop of concentrated H_2SO_4. Doubtless, other constituents may also be isolated by suitable means. Salicin has been a recognised product of plant metabolic activity and is usually isolated, as harmful, from the vital processes.

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Section of Entomology,
Department of Agriculture,
Bangalore,
November 4, 1938.

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1 *A Monograph of British Aphids*, 1875.

Ovulation in Fish.

(Effect of Administration of Extract of Anterior Lobe of Pituitary Gland.)

The sex stimulating harmone of the anterior lobe of the pituitary gland has been the subject of considerable research in connection with the Mammalia, Reptilia and Amphibia, but so far very little work has been done on the Pisces. Cardoso (1934 *b*) studied the relationship of hypophysis and sexual glands in the young and immature *Pimelodus clarias* in S. Francisco River (Brazil) and the results showed that the development of the sexual glands is controlled by the pituitary. Injections of fresh extracts of hypophysis produced a big increase of the sexual organs, and in mature *Pimelodus* sp., it was possible to induce ovulation by daily injections of pituitary extract. Ihering (1935) obtained ovulation with injection of pituitary extract on *Astynax*. Young and Bellerby (1935) studied the effect of the administration of the preparation of the anterior lobe of pituitary on metamorphosis of Lamprey, but were not able to induce it by injection of anterior lobe extract.

So far as can be ascertained no investigation on the effect of the administration of the anterior lobe of the pituitary gland has been carried out on fishes in India. The Indian Carp (*Cyprinidæ*), the most important of the fresh-water fishes, breed in nature in June and July when the streams are flooded by the monsoon rains. If the floods are not in time or are insufficient, the fish refuse to spawn and become egg bound (Hamid Khan, 1924). So far all attempts to make the fish, such as *Rohu* (*Labeo rohita*), *Morakha* (*Cirrhina mrigala*) and *Theila* (*Catla catla*), breed in tanks and ponds, which are not subject to floods, have not succeeded. With a view to elucidate the factors which stimulate the Indian Carp to spawn, investigations on the effect of the extract of the anterior lobe of the pituitary gland were undertaken in 1937 and 1938 and the results so far achieved, are embodied in the present paper.

I am indebted to Professor J. Gray and Dr. G. S. Carter of the University of Cambridge for suggesting the lines of research to be followed in this connection.

Cirrhina mrigala H.B., a common carp in the Punjab, attaining three feet in length

and fifteen to twenty lbs. in weight, was selected for experiment. The fish were in their third year and quite mature, but on account of their stunted growth in captivity, their size varied from 8 inches to 10 inches. The experiments were started in June in 1937 and in July in 1938. The preparations used were: Anterior Lobe Pituitary Gland (Tablets P. and D.), Antiturin S. (P. & D.) and Prolan (Bayer). The first preparation was administered in Ringer's solution (Bayliss, 1931) and the other two, in sterilized distilled water. Each tablet of Anterior Lobe Pituitary Gland contains $2\frac{1}{2}$ gr. (0·16 gm.) desiccated Anterior Lobe, equivalent to $12\frac{1}{2}$ gr. (0·8 gm.) of the fresh substance. It was administered in the strength of 3·2 mg. to 6·4 mg. per injection once a week. Of the other two preparations 1 c.c. contains 100 rat-units (R.U.). Various strengths were obtained by dilution with sterilized distilled water and were administered in the strength of 5 to 10 R.U.

5 R.U. injection was given to three lots of fish. The first lot received one injection, the second two, and the third three injections per day. 10 R.U. was given to two lots: one lot receiving one injection daily and the other, one injection on alternate days. The injections were given by means of a hypodermic syringe in the dorsal muscles of the fish, and 3% salt bath was given to the fish daily to prevent growth of fungus. The fish kept as control were injected with sterilized distilled water.

The fish under investigations were kept in glass aquaria. Aeration was maintained either by Semper's Aerating apparatus working with water tap or by electric chemical pump. The oxygen and carbon dioxide of the water were daily tested. The dissolved oxygen (Wrinkler) ranged from 1·068 to 4·806 c.c. per lit., and free carbon dioxide from 0·632 to 3·439 c.c. per lit. The pH ranged from 7·5 to 8·5. The fish during their captivity were fed on Hydrilla planted in the aquaria and on Crustacea such as *Moina* and Cyclops.

The injected fish were examined from time to time to see their condition. It was observed that in the case of Anterior Lobe of Pituitary Gland, 16 mgm. and in the case of the other two preparations 40 R.U. were sufficient to induce ovulation. With the last two preparations it was after 96 hours, when the fish had received 40 R.U., that the fish yielded eggs on stripping. The amount of harmone greater than 40 units in no way hastened the process of ovulation, while a lesser amount retarded it. The males yielded milt readily even without injections.

Artificial fertilization of eggs, obtained by stripping, by mixing them with milt from the male was, however, not successful. Further investigations in this direction are needed. The control females injected with sterilized distilled water were tested at the same time but they did not yield any eggs.

The behaviour of the Indian Carp under investigation seems to indicate that it is the pituitary sex harmone which is directly responsible for ovulation. The discharge of such harmone into the blood may be a consequence of some meteorological phenomenon such as rain, and flood, or some chemical or physical evnironmental factor such as pH, oxygen, carbon dioxide turbidity and density of water, temperature or some chemical salts in the water. These external factors still remain to be investigated.

HAMID KHAN.

Lyallpur,
Punjab,
October 18, 1938.

Bayliss, W. M., *Principles of General Physiology*, London, 1931.

Cardoso, D. M., (1) *C. R. Soc. Biol., Paris*, 1934, **115**, 1347; (2) *Arch. Inst. Biol., São Paulo*, 1934, **5**, 133.

Hamid Khan, *Journ. Bomb. Nat. Hist. Soc.*, 1934, **29**, 958.

Ihering, R. von, *Zool. Anz., Leipzig*, 1935, **3**, 273.

Perira, J., and Cardoso, D. M., *C. R. Soc. Biol., Paris*, 1934, **116**, 1133.

Young, J. Z., and Bellerby, C. W., *Journ. Exp. Biol.*, 1935, **12**, 246.

Evolution of the Vegetative Form in the Gesneriaceæ.

THE present note has been inspired by a recent paper of Sir Arthur W. Hill[1] on "The monocotyledonous seedlings of certain dicotyledons, with special reference to the Gesneriaceæ". This paper opens with a discussion of certain dicotyledonous genera whose seedlings normally possess only a single cotyledon instead of the normal pair. The author shows that in every one of these

cases there is no evidence in favour of Sargant's theory that the single cotyledon represents two fused cotyledons. He believes that in every case the single cotyledon has resulted by the suppression of the second. This conclusion in the light of our present knowledge seems to be well-founded. The greater part of Hill's paper, however, is devoted to a consideration of the seedlings and vegetative form of certain plants of the Gesneriaceæ, belonging to the tribe Cyrtandroidæ—*Streptocarpus*, *Boea*, *Didymocarpus*, *Chirita*, *Klugia*, *Saintpaulia*, *Haberlea*, *Moultonia*, *Monophyllæa*, *Didissandra* and a few more—, in which one of the two cotyledons exhibits continued growth by means of a basal meristem, while the other generally aborts at an early stage of development. Here the author draws certain important conclusions about the evolution of these plants, but these are based on very slender evidence. They depart fundamentally from our conception of evolution in the angiosperms in that those forms which differ most from normal dicotyledons are regarded to be the most primitive. If they are not refuted, there is danger that they may be adopted by some taxonomists in the preparation of a phylogenetic classification of the family. The following remarks are, therefore, made with a view to present the evidence against these conclusions.

The author distinguishes three types in the material studied by him. The first includes the unifoliate forms like many species of *Streptocarpus* (*Dunnii*, *Wendlandi*, *polyanthus*, etc.), a few species of *Chirita*, *Didissandra sesquifolia*, *Didymocarpus pygmæa*, and the genera *Platystemma*, *Moultonia*, *Monophyllæa*, *Trachystigma* and *Acanthonema*. These possess only one leaf throughout their life, which is the persistent cotyledon greatly enlarged by basal intercalary growth. There is no trace of a plumule in the seedlings of such plants, and the flowers often arise from the leaf midrib.

The second group, Rosulatæ, is characterised by the plants developing a rosette of a few leaves. It includes other species of *Streptocarpus* (*Rexii* and *parviflorus*), *Chirita Trailliana*, and the genera *Saintpaulia*, *Ramondia*, *Haberlea*, etc. In these one cotyledon is retained, as in the unifoliate series, and is usually the largest leaf of the rosette. No plumular axis is developed in this group also.

The third group, Caulescentes, includes several species of *Streptocarpus*, most Chiritas *Briggsia*, *Klugia* and some other genera, consisting of herbaceous plants with well-developed leafy shoots. These differ from normal herbaceous dicotyledons only in the seedling structure, which is quite similar to that of unifoliate forms, and the development of a functional bud in the axil of the persistent cotyledon which often grows as vigorously as the main axis and makes the plant markedly one-sided.

The distinction between the three groups, however, is not absolute. Some species of *Chirita* (*bifolia*, *monophylla*, etc.), which are normally unifoliate, develop under certain conditions a second small leaf. Some others like *C. capitis* and *C. hamosa* are unifoliate when growing on rocks or under other unfavourable conditions and caulescent when growing in more favourable habitats.

From a comparison of these types the author concludes that the unifoliate genera and species represent the primitive conditions and the caulescent forms are derivates from ancestors which had assumed the unifoliate habit. This conclusion is based chiefly on three arguments. (i) In *Chirita lavandulacea* the large cotyledon and the lower foliage leaves have fairly long petioles, and the lower flowers are truly axillary. The upper floriferous leaves are almost or completely sessile and produce flowers from their midribs, exactly as the flowers are borne along the cotyledonary midrib in monophyllous species of *Streptocarpus*. For this reason one of these flower-bearing leaves of *Chirita* is regarded by the author as equivalent to that of a unifoliate *Streptocarpus* and it is suggested, when a herbaceous *Chirita* reaches the flowering stage, it exhibits a reversion to the ancestral condition. (ii) it explains the anisophylly of the cotyledons even in the caulescent forms. (iii) The appearance of monophylly in dimorphic species of *Chirita* when grown under unfavourable conditions is a reversion to the ancestral state.

A careful consideration of these arguments shows that there is not much force either in the first or the third, and the second by itself cannot have much value. That floriferous shoots in their form show reversion to the ancestral condition is a quite unproved assumption. Jeffrey,[2] who did much to clearly formulate the principles of

comparative morphology, has clearly warned about the application of the doctrine of conservative parts to the reproductive shoots of the angiosperms. Similarly, in the dimorphic species of *Chirita*, the caulescent form can as well be regarded as a reversion as the unifoliate form.

The greatest objection to Hill's conclusions, however, is that these are not based on a broad foundation of comparative morphology, nor is evidence presented from any other source to support them. In considering the evolution of these atypical plants of the Gesneriaceæ, he has paid no attention at all to the structure of the related forms. His conclusions might have been correct, if the Gesneriaceæ had been the only family of flowering plants on this earth. It is, however, only one of many. It is further closely related to the families Scrophulariaceæ, Orobanchaceæ and Bignoniaceæ; and the order Personales in which these families are placed is believed to have been derived from the orders Boraginales and Solanales. Such specialised unifoliate forms as are found in the Gesneriaceæ are absent in these orders and families. To regard them primitive for the Gesneriaceæ, therefore, is quite unsound.

From a comparison with the related families, the course of evolution in these atypical Gesneriaceæ appears to be as follows. The first change from normal forms appears to have been the development of the anisophylly of the cotyledons. At first the two cotyledons might have been merely unequal in size. Later the larger one of them became more specialized. It developed an intercalary meristem at its base and a functional bud in its axil. In this manner, the above-described caulescent forms came into existence. Further reduction and specialization of these, perhaps under the influence of unfavourable habitats, may be supposed to have led to the origin of the rosette and finally the extraordinary unifoliate types.

A. C. Joshi.

Department of Botany,
Benares Hindu University,
September 9, 1938.

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[1] *Ann. Bot.*, *New Series*, 1938, **2**, No. 5.

[2] *The Anatomy of Woody Plants*, Chicago, 1917.

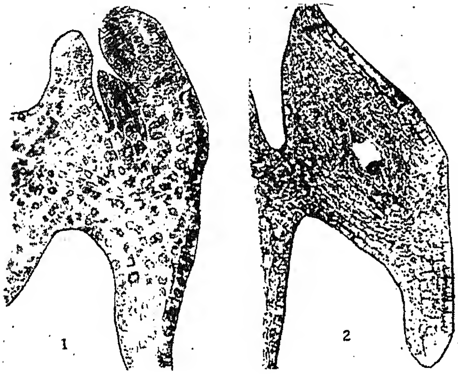
A Note on the Morphology of the Ovule of Rubiaceæ with Special Reference to Cinchona and Coffee.

In a recent paper on "Endosperm and Perisperm of Coffee with notes on the Morphology of the Ovule and Seed Development", Houk (1938) has revived a view about the structure of the Rubiaceous ovule that had been long given up. As coffee seed is a product of great economic value and a correct knowledge of its structure is very important for genetical studies, it is desirable to review his work.

The mature ovule in the family Rubiaceæ generally consists of many layers of uniform parenchymatous tissue surrounding the embryo-sac. It is not possible to make out a nucellus distinct from the integument. The micropyle is very slender and somewhat indistinct. It can be made out only in perfectly median longitudinal sections and with the help of high magnifications. It is no wonder, therefore, that the morphology of the ovule of Rubiaceæ became a subject for discussion in the last century and Schleiden (1837) stated that it consists of nucellus without integument, while of 1902 Llyod introduced the concept in 'integument-nucellus'. The correct position, however, has been indicated by Schnarf (1931) in his recent review of the embryology of the angiosperms. It is that the ovule of the Rubiaceæ consists of a poorly developed nucellus and a single integument. This view is based on the development of the ovule. It is seen that in the early stages the nucellus and the integument are quite distinct from each other. The micropyle also is quite prominent, but the amount of nucellus, as in the Gamopetalæ in general, is very small. It consists only of a single layer surrounding the megaspore-mother cell. As the embryo-sac develops, this layer of nucellar cells is crushed ; and the embryo-sac comes to be situated directly to the inside of the integument. In the meanwhile by the growth of the integument the micropyle becomes nearly obliterated. This ovule thus begins to give the deceptive appearance described above.

This point is well illustrated by the accompanying figures from *Cinchona succirubra*. Fig. 1 represents a longitudinal

section of an ovule at the megaspore-mother cell stage. The single integument, a distinct though poorly developed nucellus and the micropyle are clearly seen. Fig. 2



Cinchona succirubra.
Longitudinal sections of ovules.

FIG. 1, at the megaspore-mother cell stage; FIG. 2, at the mature embryo-sac stage. Fig. 1 is more highly magnified than Fig. 2. The microphotographs have been slightly touched to make the boundary of the ovules more distinct.

shows a similar section of an ovule containing a mature embryo-sac. The integument now has completely surrounded the nucellus. The latter has completely disappeared and the micropyle has been nearly obliterated. It could be made out in this section by using a higher magnification.

The ovule of coffee passes through the same stages of development as that of *Cinchona* and should be interpreted in the same way. Faber (1912) who studied the morphology of the coffee flowers more than twenty years ago, has very clearly sketched these changes and correctly described the ovule to possess a weakly developed nucellus and a massive integument. Houk (1938), however, rejects this generally accepted view about the morphology of the Rubiaceous ovule for coffee. He asserts that Faber's interpretation is untenable and supports the older Llyod's 'integument-nucellus' concept but gives no reasons for any of these conclusions. In a paper dealing with the morphology of the ovule, which he takes to be different from that of other flowering plants, he makes no reference to the early stages of ovule development. His views are thus not based on any strong evidence and should be rejected. If he had just studied the development of the ovule, he would have undoubtedly found the stages in its development described by Faber and agreed with his findings.

Another point discussed by Houk is the nature of the nutrient tissue surrounding the embryo. He shows that the endosperm formed is very small in amount and evanescent, and therefore regards the nutrient tissue as perisperm. In the light of what has been said above about the morphology of the ovule, this is only a part of the integument of the ovule and is thus a part of the testa. The small nucellus which is present in the young ovules is crushed early by the growing embryo-sac and does not persist in the seed. The general statement, "Embryo small, in rich endosperm" (Willis, 1931), found in books on systematic botany about the structure of the Rubiaceous seed appears to require modification. It is very likely that what has been regarded as endosperm in many cases is only a part of the testa.

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November 8, 1938.

[1] Faber F. C. von, *Ann. Jard. Bot. Buitenzorg*, 1912, **25**, 59–160.
[2] Houk, W. G., *Amer. Journ. Bot.*, 1938, **25**, 56–61.
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[4] Schleiden, M. J., *Arch. Naturgesch.*, 1837, **Abt. A3**, 289–414.
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Flowering Branches from the Curd of *Brassica oleraceae* Linn. var. *botrytis* D.C.

A RECENT article on the development of the flowers from the curd of Broccoli by S. O. S. Dark (1938) prompted the writer to report a similar phenomenon in the cauliflower, photographed in 1934 and subsequently noticed in several localities. The structure of the curd of cauliflower does not appear to have been properly understood. According to Masters (1849) and Worsdell (1915) the flower stalks in the curd of Broccoli and cauliflower are hypertrophied and the flowers are either defective in development or they are not developed or only with a vestigial calyx. Goebel (1900) while

considering the relationships between the flowers or the organs of reproduction in general and the vegetative parts, mentions that in the inflorescence of the cauliflower the flower stalks are abnormally thickened and fleshy; and correlates this feature with the abortion of the whole flower as evidenced by *Celosia cristata*, *Muscari comosum* and Cauliflower. In the opinion of Baily (1919) *Brassica oleraceæ botrytis* is a form of common cabbage species producing an edible head of malformed and condensed flowers and flower stalks.

The formation of the curd is generally the termination of only the vegetative phase of cauliflower and the reproductive phase follows, if the curds are allowed to grow further under congenial conditions. According to Baily, the breaking up of the curd is an indication of the formation of the floral parts. The curd of cauliflower usually breaks up after its full formation and a number of its branches shoot up bearing bract-like leaves all along and a terminal cluster of normal flowers (Fig. 1). Hence, as

An entire plant of Cauliflower (*Brassica oleraceæ* Linn. var. *botrytis* D.C.). The breaking up of the curd and the development of number of branches bearing flowers can be seen.

stated by Dark, the curd is evidently an intermediate stage between the vegetative and the reproductive phases in the life-history of the cauliflower and Broccoli. "The curd developing phase" of cauliflower can thus be compared with the condition specially evident among the cereals, *viz.*, "the formation of tillering node". When the inflorescence of cauliflower has completed its embryonic development, then the meristematic growth commences and a rapid elongation of the parts sets in.

L. NARAYANA RAO.

Central College,
Bangalore,
October 30, 1938.

1 Baily, L. H., *The Standrad Encyclopedia of Horticulture*, 1919, 2.
2 Dark, S. O. S., *Ann. Bot.*, N.S., 1938, 2, 7.
3 Goebel, K., *Organography of Plants*, 1900, vol. 1.
4 Masters, M. T., *Vegetable Teratology*, 1849.
5 Worsdell, W. C., *Principles of Plant Teratology*, 1915.

An Important Genetic Constant.

CH. NEK ALAM in a very interesting paper appearing in *Current Science*[1] has stated that the segregation constant of quantitative characters is approximately 3. Appreciating his statement I shall point out that his constant might be applicable in the cases when all gametes formed by F_1 hybrids are viable and when no competitive pollen-tube growth takes place. Self-incompatible plants (rye, sugar, beet, etc.,) in which competitive pollen-tube growths occur (often termed as selective fertilization, as for example, in certain strains of maize) the segregation constant might not be 3 or about that, since certain types of gametes are eliminated. (Some quantitative characters can be linked with those regulating pollen-tube growth.) Structural hybridity is also a factor that would condition considerable deviations from the Nek Alam's segregation constant, since they form usually a variable percentage of non-viable pollen (also gametes) and their viable pollen grains have often differential pollen-tube growth. Structural hybrids also produce certain types of non-viable zygotes, which also can condition a deviation from the normal constant.

DONTCHO KOSTOFF.

Institute of Genetics,
Academy of Sciences of USSR,
Moscow,
October 1, 1938.

1 *Curr. Sci.*, 1938, 7, 2.

REVIEWS.

Van Nostrand's Scientific Encyclopædia. (Chapman & Hall, Ltd., London), 1938. Pp. 1233. Price 50*s*. net.

We have had extensive opportunities of using this work and feel convinced that besides scientists, the intelligent public also will find it indispensable. To have brought within the compass of a single volume such a vast amount of knowledge covering all the modern developments of basic sciences and their applied branches, is an impressive achievement on which the authors and publishers deserve warm and unstinted congratulations. The responsibility of dealing with each of these principal fields of knowledge has been entrusted to a single author who, however, had the benefit of consulting a number of experts, and the work as a whole, while possessing all the advantages of a unitary treatment, gains immensely from the authoritative collaboration. The results of such co-operation are reflected in the progressive development of the discussion of topics, each, commencing with a simple definition stated in easy terms, receives a full treatment of all the principal aspects necessary for a complete comprehension of the subject. Where, however, the nature of the subject demands a fuller treatment, the authors have given the information in fairly long articles, the technical features being fully illustrated.

We recognise that there must be limits in the compilation of a one-volume book, especially regarding the length of articles and the number of illustrations. We claim to have consulted the book practically in all branches of knowledge with which it treats, and we have in every case found that the explanations given are adequate, lucid and up-to-date. We are greatly impressed by the comprehensiveness of the scope and the treatment of the topics of the book, rendered possible by the system of cross-indexing. By this system the user of the book is enabled to obtain a comprehensive treatment of each term by consulting the references under several heads, such terms being printed in bold face type. A book of reference of the type under review is a work of supreme necessity, as most of the transactions in every field of civilised communities have a wide bearing on the applications of scientific method, and a knowledge of the general facts and principles of the basic sciences being indispensable to people in technical and general service. In fact an intelligent understanding of the progress of events in the world implies a fairly wide acquaintance with scientific terminologies, and we know of no work of reference which helps the general reader of daily news and popular scientific journals to acquire a more competent knowledge of such terms than Van Nostrand's *Encyclopædia*. We have found that in certain fields of study, the book presents information in a readily assimilable form, for which, in its absence, one would perhaps have to digest large and special treatises for obtaining the same amount of mental nutrition. The worth of the book lies in the strong appeal it has for the general cultured public and for those engaged in scientific and technical pursuits.

Social Psychology. By Daniel Katz and Richard L. Schank. (John Wiley & Sons, New York; Chapman & Hall, Ltd., London), 1938. Pp. xiv + 700. Price 18*s*. 6*d*. net.

This book will be a welcome addition to the growing volume of literature on the subject of social psychology whose importance in its relations to human problems is widely recognised. It is a successful attempt for assimilating the large body of facts and concepts in the field of social science into a systematic framework. The chief value of the book lies in the fact that it gives a fairly comprehensive treatment of the experimentally derived knowledge, and in the unity in the plan of approach of the materials and problems from the view-points of different authors who have investigated them. In the first part the reader finds a full and competent description of the social world of every-day experience, "the actions and ideas of people in terms of conformity and non-conformity, taboos and mores, crimes and customs, co-operation and competition". These social events follow a natural psychological order and each is described adequately. In the second

part, a detailed analysis is given of the mechanisms of these social events, the motives and processes underlying them, based on experimental data. Part three is devoted to the exposition of human personality, the socialization of the individual, the internationalization of cultural values, prohibitions and social conflicts. This section is a revelation of the social world as seen through the eyes of the clinician or psychiatrist. The social drama as it appears to the social engineer or planner forms the subject-matter of Part Four of the book. This section forms really what is known as collective psychology whose problems are the complicated interrelationships of human beings in their individual capacities and of the society as a whole. The four sections constitute a perfectly natural and logical development of the whole theme, and the readers will be delighted to follow the descriptive account leading to an incisive analysis of the experimental findings and then introduced to the genetic account of the social phenomena, finishing up with a historical and dialectical treatment of the whole subject-matter of multi-individual behaviour.

Human sciences like social psychology which have profoundly affected the contemporary philosophic thought, are likely to assume the responsibilities of authoritative leadership of public affairs, and the results obtained from their investigations, which ultimately underlie the acts and policies of statesmen, ought to form an indispensable part of their mental equipment. Social psychology forms the foundation of political science and economics and gives a new orientation to the general line in the field of administration. The scientific objectivity and discipline which are emphasised in the treatment of the perceptual data underlying social psychology, invest the book with the rigorous precision of exact sciences.

We have nothing but praise for the authors who have written the book in an easy and lucid style. The facts are presented in their natural order of psychological sequence. Every chapter is stimulating. The whole book is thoroughly enjoyable. It is one of the few works on social psychology which an elementary student, a scholar and a statesman can read with pleasure and profit.

Solid Mensuration with Proofs. By W. F. Kern and J. R. Bland. (Chapman & Hall, Ltd., London). 1938. Second Edition. Pp. vii + 172. Price 10*s*.

This is a comprehensive book on the mensuration of solids, and is written so that even a beginner can use it profitably to solve practical problems. The first chapter contains a resumé of the formulæ for plane figures, including Simpson's rule for the approximate evaluation of an area. The second chapter gives the preliminary notions and theorems on lines, planes and angles in space. The next three chapters contain a discussion of the volume and surface of (*a*) cube, prism and cylinder, (*b*) pyramid and cone, (*c*) frustum of prism, cylinder, pyramid and cone. The sphere, with its zones, segments and sectors, comes up next for treatment. The seventh chapter is devoted to the solids of revolution, and the eighth to the general prismatoid. The last chapter gives the summary of all the formulæ employed, and also a collection of reference theorems from plane geometry.

In the Appendix the authors try to prove the theorem on limit that "if two variables are always equal and each approaches a limit, the limits are equal". For those students who are familiar with the notion of limit, this theorem would be quite obvious without any proof, but for those unacquainted with the idea of limit, the whole proof seems to beg the question. That is the case also with the proof of Cavalieri's theorem and of the formula for the surface and the volume of a sphere. The authors claim "the most distinctive feature" of their book to be the inclusion of "simple proofs of the volume and surface formulas". All these proofs (apart from those for the sphere) are based on Cavalieri's theorem, but the proof of this theorem itself as given in the book, is vague and intuitive, and cannot be called either simple or rigorous. It is incomprehensible why the authors ban the use of elementary calculus. Surely a student who has reached a stage where he can employ the complicated formulæ for the frustum of a solid or the general prismatoid, would have already grasped the elements of the differential and integral calculus. The calculus would enable the authors to include proofs of the theorems of Pappus also. According to the plan of their work, they should not

have employed these theorems without proving them first. After all that has been written on the foundations of mathematics, it is astonishing to find the authors trying to define familiar things like plane, etc. "A plane is a surface such that...." Do they really think that the notion of a surface is simpler than that of a plane? To prove the volume theorem on p. 27, it is required to construct a rectangular parallelepiped with a base and altitude respectively equal to the base and altitude of the given solid. Isn't this tantamount to the quadrature of the circle?

Apart from these defects, the book should prove valuable to the student of the subject. Photographic arrangement throughout the book helps a great deal in visualising solid figures. Many illustrative examples have been thoroughly worked out. A large number of problems bearing on practical affairs is given at the end of each chapter. Logarithmic and trigonometric tables at the end of the book should prove quite useful in solving problems.

The book has been vary well printed, but the price appears to be inordinately high.

M. R. S.

Physik fur Studierende an Technischen Hochschulen und Universität. By Ingenieur Dr. Paul Wessel, edited by Dr. V. Riederer von Paar. (Verlogvon Ernst Reinhardt, München), 1938. Pp. 54. Price R.M. 4·90.

This book is designed to suit the requirements of undergraduate students of Physics inasmuch as it deals with almost all the useful branches of the subject in fairly easy style and covers even the most modern achievements of science. Numerous applications from allied sciences are given and that obviously increases the utility of the book.

The work is divided into sections, outlines of Physics, short revision and collection of formulæ, examples and answers and tables and numerical data.

The author has in this manner succeeded in making the book useful to the interested reader, even beyond his immediate need, *viz.*, the passing of a certain examination. A technician, a chemist, a medical man, in fact anyone who is required to use the results of physics, will readily find the necessary result in this compact volume.

The diagrams in the text are simple, some of them are modern and very attractive; *e.g.*, the diagram on p. 185 illustrates the behaviour of paramagnetic and diamagnetic bodies in a magnetic field; the periodic system chart on p. 327 is certainly ingenious.

Modern topics like the atomic structure, nuclear physics, sound films, television, principle of uncertainity and many others are all included in the volume.

The amount of matter that finds itself compressed into this single volume is large, consequently the statements are very brief and pointed; lengthy descriptive explanations are carefully avoided. It is in this respect that the beginner would naturally find considerable difficulty. He would not be able to use the book for learning Physics, but as a book of reference the compilation is unique and should prove valuable.

G. R. P.

Statistical Tables for Biological, Agricultural and Medical Research. By R. A. Fisher and F. Yates. (Oliver and Boyd, London), 1938. Pp. viii + 90. Price 12*s.* 6*d.*

Coming, as it does, after a period of rapid development in Applied Statistics to which Professor Fisher himself has contributed a large share, this book of tables is a valuable supplement to his *Statistical Methods for Research Workers.* The "Statistical Tables" will be a very useful aid to computation and interpretation of data for a research worker using modern statistical methods. In preparing the tables, the authors have paid particular attention to the needs of the practical worker. For instance, Table X will facilitate the ready use of data given in proper fractions for finding the corresponding normal deviates although the same values can be determined from Table IX by converting the fractions to percentages.

Tables I–VII cover the same ground as the tables published in the *Statistical Methods for Research Workers*; but there are many noteworthy improvements. The addition of the values for $P = \cdot 001$ in tables for t, x^2, and r increases the usefulness of the tables and the distribution of z has been tabulated for four levels of significance. An important addition to this set is the table of distribution of Variance Ratio for 4 levels of significance, *i.e.*, 20, 5, 1, 0·1 per cents. This form of the table will be

very useful for comparing variances. The Latin Squares and the available Combinatorial Solutions of Balanced Incomplete Blocks given in Tables XV–XVII will help the agricultural experimenter in designing his lay-out for an experiment according to recent developments in Field Plot Technique.

The method of polynomial fitting for examining secular changes and for correlating residuals in "time-series", has been used in the past very sparingly by workers because of the arithmetical labour involved, but the values of Orthogonal Polynomials up to $n = 52$ given in Table XXIII will greatly facilitate the computation of the distribution constants up to the 5th degree. Research workers, especially in Agriculture, Meteorology and Economics, who have to deal with distribution of variables in time will find that much labour is saved by the use of these tables. Data in which only the order of the magnitude is available or reliable, can be analysed with the help of the scores for ranked data given in Table XX.

The introduction to the tables commends itself by its brevity and clearness and contains a number of worked out examples for guidance in the use of the tables. The accuracy of interpolated values for the various tables has been discussed in the last section of the "Introduction".

Apart from the special statistical tables a few of which have been mentioned above, some tables of standard functions of general utility such as logarithms, square roots, trigonometric functions, etc., are also included. Tables of random numbers and constants of weights, measures, etc., increase the usefulness of the volume still further.

The arrangement of matter, the printing and the get-up of the book are excellent, and it is sure to be invaluable to the increasing number of statistical workers in India.

V. SATAKOPAN.

Organic Synthesis. Vol. XVIII. Editor: R. C. Fuson. (John Wiley & Sons, Inc., New York; Chapman & Hall, Limited, London), 1938. Pp. v + 103; 1 Fig. Price $ 1·5.

The current volume of this valuable series contains explicit directions for the preparation of twenty-nine substances of different types among which are allylamine, barbituric acid, taurine, α-hydrindone, *l*-histidine-monohydrochloride, ethylbenzoyl-acetate, 4: 4'-difluorobiphenyl, potassium-anthraquinone-α-sulphonate, and 2-acetothienone. A convenient method for making malonic acid, and for methyl iodide from methyl sulphate in excellent yields are described. There follows an appendix containing references helpful for 34 preparations in previous volumes along with additions, and corrections. The details are sufficiently exhaustive in some cases as to reduce the work to almost mechanical routine and the book should be very helpful to those who may actually need these substances for any purpose.

B. S. R.

Insects of Citrus and Other Subtropical Fruits. By Henry J. Quayle. (Comstock Publishing Co., New York), 1938. Pp. 583. Price $ 5·00.

This book treats of a wide variety of insects of great economic importance to fruit culture specially in the subtropical regions of the world. To the horticulturists and the horticultural entomologist in particular, constantly faced with very serious problems of insect predominence in the various stages of the growth of fruit plants, the exhaustive manner ir which the numerous insect enemies are dealt with, will be found to be of immense interest and benefit.

The major insect and acarine enemies of citrus dealt with in the first four chapters, include detailed observations from the taxonomical, biological and ecological viewpoints, a combination that thoroughly clarifies the situation and leaves little else to be desired by the entomologist in the capacity of a consultant and guide. As the expansion of the citrus fruit industry in the tropical and subtropical countries depend very largely on the efficient control of a large variety of serious insect pests attacking the plants, orchardists have good reason to be grateful to the author who has furnished practical and efficacious methods based on scientific observations.

In addition, the insects attacking fruits like grape, fig, Avocado, almond and pomegranate are also described in a detailed manner.

The rodents, nematodes and snails that take their own toll from the fruit plants are discussed at length in a separate chapter. The damage caused by these animals,

however, does not amount to much; nevertheless, they are also to be controlled in time by the fruit growers.

The most important operations of fumigation, spraying and dusting that form necessary adjuncts to fruit culture on a large scale have been described very thoroughly. The resistance of certain varieties of scale insects (Coccids) to the deadly fumes of HCN and the gradual immunity developed by some others, furnish clear proof of the extraordinary structure and the wonderful plasticity of the insect system and give an insight into the toughness of the problem of control of certain classes of insect pests.

Bibliographical references, illustrative charts and graphs, tables of meteorological data and above all—the beautiful reproductions of photographs and line drawings, all abound in the pages of the book making it a very comprehensive and attractive treatise.

B. K. M.

A Manual of Foundry Practice. By J. Laing and R. T. Rolfe. Second Edition. (Chapmann & Hall, Ltd., London), 1938. Pp. 312. Price 18/-.

Methods followed in the modern foundry practice in Britain have been clearly explained in this volume and some examples are cited to illustrate the principal details of moulding, core-making, pattern shop equipment and moulding tackle. One chapter is devoted to the metallurgy of cast iron. A brief reference is made to chilled iron castings and malleable cast iron both whiteheart and blackheart. Cupola mixture calculations for British Foundry pig irons and the results of mechanical tests on the resultant irons have been tabulated for several important castings; graphs are also given showing the effects of different constituents in cast iron on its tensile strengths.

Modern developments in melting furnaces such as balanced blast cupola, air furnaces and rotary furnaces have been clearly explained. One of the chief advantages of the rotary furnaces is the feasibility of close control of composition, specially with low total carbon contents, which cannot be easily obtained in ordinary cupola melting practice.

In the last chapter non-ferrous castings are dealt with; methods of producing gun-metal, manganese, bronze and aluminium castings have been explained with examples, and practical tips are given in alloying and melting of aluminium castings.

The author has not touched upon either the production of steel castings or centrifugal and die castings; with an additional chapter on this important branch of foundry practice, the value of this work would be materially enhanced.

B. R.

Applied Mycology and Bacteriology. By L. D. Galloway and R. Burgess. (Leonard Hill Limited, London), 1937. Pp. 186. Price 10*s*.

A knowledge of the main principles of Mycology and Bacteriology is almost essential to an appreciation of the progress made in many of the industrial processes with their increasing dependence on the activities of micro-organisms. To an industrial engineer and chemist without much of a biological background such knowledge is often most necessary. A book devoid of the special terminology of these sciences and for readers of this class, however, has been overdue and Galloway and Burgess have endeavoured to write just such a book. The book is not without interest to the students of Mycology and Bacteriology who will find much in it that they did not know and a good deal to clarify their ideas.

Of the fourteen chapters of the book, the first eight are taken up by general considerations on micro-organisms, the apparatus needed for their study, methods of isolating, examining, culturing and staining them and description of structure, energy requirements and metabolism. In the next five chapters their employment in the food, fermentation and textile industries and the important part which micro-organisms play in hygiene, medicine and agriculture are clearly set forth.

How the authors could compress into about 186 pages so much useful information about fungi and bacteria without ignoring any important phase of their activity is indeed most remarkable. The book is neatly printed, and errors are very few. It is written in an elegant style and the book should appeal even to lay readers of an inquisitive disposition.

B. B. M.

A Laboratory Guide for a Course in General Botany. By Lee Bonar, Lucile Roush and Richard M. Holman. (John Wiley & Sons, New York; and Chapman & Hall, Ltd., London), 1938. Pp. 110. Price 6*s*. net.

This laboratory guide is compiled by three members of the Botanical Staff of the University of California and gives a detailed curriculum of practical exercises in an elementary course in General Borany, covering a period of one year.

In Part I are given practical exercises on the structure and function of seed-bearing plants and in Part II on the types of principal groups of plants. To each chapter is appended a large number of questions which should acquaint the student well with the whys and wherefores of what he does. It may be noted that practical exercises in the morphology and physiology of every plant organ are included together in the same chapter, thus keeping in mind the essential unity of form and function.

While teachers in Indian Universities must necessarily frame their own curricula for practical work, suited to their laboratory facilities and examination requirements, this 'guide' may prove useful in suggesting a good background to start with.

R. D. A.

Das Aufbauprinzip Der Technik. By Paul Wessel. (Verlag von Ernst Reinhardt, Munchen), 1937. Pp. 39.

The author states and explains in a simple way such broad principles of technological development as organisation, selection of materials, design, research, etc. To illustrate the application of these principles he assumes for a while that all the material wealth of the present civilization to be lost leaving only what bare nature offers and then proceeds to show the possible way of getting back the lost wealth starting with the production of crude forms of simple appliances such as surface block, straight edge, callipers, gear wheel, etc. The reader is thus made to realise the various factors upon which depends the manufacture of instruments and apparatus. This pamphlet of about 40 pages presents an interesting reading showing us how Technology has reached its present advanced state starting with very primitive conditions.

K. C.

La Duree Extreme de la vie Humaine. By E. J. Gumbel. (Herman et Cie, Paris.) Pp. 63. Price 18 *francs*.

This book deals with the problem of determining the extreme duration of human life by the study of a mortality table. It is well known that the mortality tables cannot give valid results in advanced ages. Uptil now the books dealing with this subject introduce a discontinuity in order to avoid this difficulty. But as Steffenson has remarked this raises logical difficulties. The author avoids this difficulty by treating the corresponding biometric function as continuous at the same time assuming that it will approach zero in some asymptotic way.

K. V. I.

La Ultra-Convergence dans les series de Taylor. (*Actualites Scientifiques et Industrielles.*) By G. Bourion. (Herman & Co., Paris.) Pp. 46. Price 12 *francs*.

The first systematic investigation of the over-convergence of Taylor's series is by Ostrowski in 1921. Earlier to him Porter and Jentsch had given examples which possessed the over-convergence property, *viz.*, there existed a sequence of partial sums of the Taylor-development which converged uniformly in a region *greater* than the circle of convergence. The present monograph is a systematic and methodical presentation of the subject as developed till the present day. This book contains full proofs of the theorems of Ostrowski, Losch, Carlson etc., on over-convergence, the uniformity of distribution of the zeros of the partial sums of any Taylor series which is not lacunary. Only a very elementary knowledge of the theory of functions enables one to work through the book—the only advanced theorem assumed is the fundamental theorem of potential theory which is required only for understanding the theorems in their complete generality.

The book is a very great improvement on the two earlier books which treat this subject, *viz.*, *Bieberbach-Lehrbuch der Funktioner Theorie*, Bd. II and Dienes-Taylor Series.

K. V. I.

Analogies entre les Principes de Carnot, Mayer et Curie. par Paul Renaud. (No. 516 of Actualites Scientifiques et Industrielles, Hermann et Cie, Paris), 1937. Pp. 47. Price 10 *fr.*

The author considers the first and second laws of thermodynamics as disguised definitions based on a strict validity of causality, but having the power of correlating a number of experimental results and therefore of practical utility in certain fields. He exhibits the analogy between these principles and a generalization of Curie's principle which is stated as follows: "If an assemblage of causes is invariant with respect to any transformation, the assemblage of effects must also be invariant with respect to the same transformation". This principle is also shown to be a disguised definition and examples are considered to show how the first and second laws of thermodynamics may be derived from the generalization of Curie's principle. The reasoning is acute and throws an interesting light on these principles.

La Structure des Corps Solides dans la Physique Moderne. par Leon Brillouin. (Actualites Scientifiques et Industrilles, No. 549; Hermann et Cie, Paris), 1937. Pp. 55. Price 18 *fr.*

In this brochure Prof. Brillouin gives an illuminating account of some phases of the development of the theory of the solid state, including particularly the theory of elasticity. In connection with the restrictions imposed by wave mechanics on the applicability of Born's lattice theory a beautiful description of the wave mechanical model of the atom in various spectroscopic states is included. The author's own theory based on a modification of Debye's ideas is just outlined at the end. There can be no hesitation in saying that, in accordance with his object in writing the pamphlet, Prof. Brillouin has eminently succeeded in arousing our interest in a widening field of research so well illumined by his own labours.

Spectrographie de Masse: Les Isotopes et leurs Masses. By Louis Cartan. (Actualites Scientifiques et Industrielles, No. 550; Hermann et Cie, Paris), 1937. Pp. 91. Price 20 *fr.*

This is a lucid account of the conditions to be fulfilled by a mass spectrograph in order to attain good focussing and high resolution, and the ingenious ways in which the instruments of Aston, Bainbridge, Dempster, Mattauch, Nier, and others, have been constructed so as to achieve these results. The mathematical analysis leading to a discovery of these conditions is not included. It is written by one who has a good deal of practical experience in the subject and the information contained represents what is essential for successful work. The results so far obtained have been discussed and tabulated. The latest figures given by Aston and Dempster and reported in *Current Science* modify but slightly the values recorded in the brochure. It may be recommended to all desirous of acquiring a critical knowledge of the theory and practice of mass-spectroscopy.

La Polonium. By M. Haissinsky (Actualites Scientifiques et Industrielles, No. 517; Hermann et Cie, Paris), 1937. Pp. 44. Price 12 *fr.*

Here we have an account of the preparation and properties of Polonium. The electrochemistry of the element is treated at length. One can here understand and admire the ingenuity expended in determining the properties of a substance available in such small quantities. The pamphlet is a valuable addition to the literature of the subject.

Regions ionisées de Haute Atmosphère. By R. Rivault. (Actualites Scientifiques et Industrilles, No. 547; Hermann et Cie, Paris), 1937. Pp. 91. Price 20 *fr.*

The author here describes the results obtained by him during the course of a long investigation regarding the propagation of short electromagnetic waves (41·5 and 74 metres). The method employed was novel in that an object of the form ⊣ < was televised, and the multiple displaced images due to the direct waves and those reflected at the various ionised layers of the atmosphere were recorded on a moving photographic film. A study of these displacements has led to a number of interesting results which are here set forth in detail. The author could not get any indication of the reflected waves when the receiver was less than about 3 km. from the sender. On the other hand, he has also found images due to multiple reflections from the same layer. Apart from confirming

some results due to previous workers, the author has thus observed some new phenomena. Another of these is the redoubling of each of the ordinary and extraordinary waves. The method employed had also the advantage of allowing the phases of the several waves to be determined. We congratulate the publishers on making these results available in this form to a larger public.

Physical Geography for Indian Students. By Dr. C. S. Fox. (Macmillan & Co., Ltd., London), 1938. Pp. 1–544. Price Rs. 5.

We are glad to welcome this book by Dr. C. S. Fox of the Geological Survey of India on "Physical Geography for Indian Students". This is a completely revised and enlarged edition of Simmons and Stenhouse's Class-book of Physical Geography adapted particularly to meet the requirements of Indian schools and colleges. The book is divided into three parts—Part I dealing with map-making and astronomical geography, Part II with land and sea, and Part III with climate. In the first part, the author gives an elaborate account of the different kinds of Maps, together with an explanation of the broad principles involved in map-drawing and projection. In Part II, we have first a general account of the nature and distribution of land and sea areas, and then, a full description of the work done on the earth's surface by various dynamical agents, such as rivers, glaciers, lakes, volcanoes and earthquakes. This naturally leads on to a consideration of the origin of rock masses, and the part played by their structure and denudation in determining the topography of a country, thus revealing the intimate relationship between underground geological structure and surface physical geography. Part III is devoted to the study of climate in all its aspects, especially in influencing the geographical distribution of plants and animals, including Man.

The treatment of the subject-matter throughout the book is eminently practical. At the beginning of each chapter are suggested a few simple experiments with a view to make the student an independent observer, and develop in him a capacity to interpret intelligently the phenomena he observes, and their bearing on the subject under consideration; at the end of each chapter again, are given a series of exercises which will enable the student to find out for himself how much of the contents of the chapter he has just read, he has been able to clearly understand and appreciate. The text is packed with a lot of useful information not only on physical geography, but also on several other allied subjects such as astronomy, geology, meteorology and physics, and is profusely illustrated with examples, diagrams and sketches, mostly from India, some of which are of more than usual interest. By his wide and intimate knowledge of the country about which he is writing and aided by the remarkable lucidity of his exposition, Dr. Fox has succeeded in writing a really popular text-book of Physical Geography for Indian students; and we have no doubt that this valuable service he has rendered to the cause of geographical studies in India, will be widely appreciated.

L. RAMA RAO.

Annales Bryologicii, Vol. IX. Edited by Fr. Verdoorn. (Chronica Botanica Co., Leiden, Holland), May 1937.

Recent taxonomic studies have shown that Taxonomic Bryology is not so sound as it seemed to be. The necessity of critical revision of certain groups and large genera is being felt very keenly. It is gratifying to note that Dr. Fr. Verdoorn (Editor: *Annales Bryologicii*) has been able to secure the co-operation of a number of authors to undertake such revision. A number of such articles is a special feature of this volume. Chalaud's article points out a new line of work. Bryophyta Nova section should be enlarged. It would add to the value of the section if the editor manages to secure the co-operation of more Taxonomic Bryologists. The authors should also make it a point to publish a new species in this section and not in the journal with a limited local circulation. When new species are described during the course of a year in international journals reference to these may be given at the end of this section. It is needless to point out that "Reviews of Recent Researches" and "Miscellaneous Notes" section are very useful. Considering all these points one can safely assert that a set of *Annales Bryologicii* should be within easy reach of every worker in the domain of Bryology.

R. S. CHOPRA.

Recherches Sur la Théorie Cinétique Des Liquides—I. Fluctuations en Densité; and II. La Propagation et la Diffusion de la Lumiére. par J. Yvon. (Actualités Scientifiques et Industrielles, Nos. 542 and 543, Exposés, Théories Méchaniques.) (Hermann et Cie, Paris), 1937. Price 18 *fr.* each.

The present numbers of the series deal with the theoretical study of the scattering of light in liquids without change of wave-length. It is well-known that the problem of the scattering or the diffusion of light in liquids is directly connected with their internal structure. Assuming a complex structure the author has derived an expression for the intensity of scattering in a monoatomic liquid like liquid argon. The classical treatment has been adopted and the rôle of thermal agitation in the fine structure of the light diffused has been neglected. The experimental verification of the formula obtained by the author for the intensity of scattering serves as a criterion to the structure adopted by him for the liquid. Unfortunately experimental data are lacking in the case of monoatomic liquids. Unless the treatment is extended to the case of more complex molecules it will remain as a mathematical curiosity. This brochure is well worth a close study by those interested in the general question of the structure of liquids.

R. S. K.

The Plant Diseases of Great Britain. By C. G. Ainsworth. (Chapman & Hall, Ltd., London), 1937. Pp. 273. Price 15*s.*

This book is mainly a collection of the key references for the principal diseases of plants in Great Britain; and is of considerable help to plant pathologists. The valuable information given in the notes under the references in this book and the reference to abstracts, in the *Review of Applied Mycology*, of papers in foreign languages will be greatly appreciated by every worker in this field. As pointed out by Dr. E. J. Butler, in the Foreword, this list provides information about plant diseases in Great Britain, that might cause damage if introduced. If every country publishes its list, it will meet an international need.

M. J. N.

An Atlas of Indian History. By E. W. Green, B.A. (Oxon.). (Macmillan & Co., Ltd., London), 1937. Pp. 43. Price Rs. 2.

Undoubtedly the *Atlas* prepared by Mr. E. W. Green must be indispensable to teachers of Indian History in the secondary schools and, we would venture to suggest, must be found an invaluable aid even in the collegiate classes. The new methods of teaching the high school subjects insist on a close correlation being established for a proper and rational appreciation of their contents, and without the assistance of maps depicting the rise, growth and decay of ancient kingdoms, the great historical movements and events will not have delivered their message to the pupils. The *Atlas* contains twenty beautifully coloured maps, with short explanatory notes, and between them is a condensed summary of the historical vicissitudes of India from the earliest times (6000–2500 B.C. to 1858–1930 A.D.) to the present day. No student of the high school classes, or for the matter of that of the intermediate colleges can follow the lectures in Indian History without an atlas of this kind.

A Text-Book of General Botany for Colleges and Universities. By Richard M. Holman and W. W. Robbins. Fourth Edition. (John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London), 1938. Pp. xvii + 664. Price 20*s.* net.

The first edition of this well-known text-book appeared in 1924 and now this is the fourth—which speaks in itself for the favourable reception it has received from both teachers and students. The senior author, Dr. Holman, died soon after the publication of the third edition in 1934.

The morphological part of the book is thoroughly satisfactory. The illustrations are however remarkably unequal. Most of them are excellent; some are amateurish but sufficient for the purpose; others are so poor that they should never have been included in a book of such quality. This defect seems to be due to the fact that the authors utilised the services of students or inexperienced draughtsmen for making some of the drawings.

Of the types used in Part II, we think that wheat and corn are not suitable for a study of the development of the embryo-sac and endosperm, since the number of

antipodal cells is abnormally large in both cases.

The chapter on Mendelism seems out of date and portions of physiology need further improvement.

On the whole, the book is very suitable for elementary students. It is to be hoped that the publishers will try to bring down the price to a more reasonable figure.

P. MAHESHWARI.

The Soils of Palestine. By A. Reiferberg. Translated by C. L. Whittles. (Thomas Murby & Co., London.) Pp. viii + 131. Price 14*s*. net.

This monograph dealing with the soil formation in Palestine, is a valuable addition to the existing literature on the evolution of soils and their classification. It is a record of extended researches of the author on the soils of Palestine.

The subject is dealt with in five chapters, the first three devoted to the study of soils in Palestine and the other two to the application of the results of such a study to the advancement of agriculture after the Zionist colonisation.

The author narrates in a lucid manner the general characteristics of the soils and their evolution as influenced by the Mediterranean climate. Special mention has been made of the critical study on the "Terra rossa" soils. After reviewing the prevailing theories on its evolution the author postulates a new one based on the chemical and colloid-chemical reactions taking place under the Mediterranean climate. Evidence has been presented to show the dominating influence of climate on the evolution of soil types. The treatment of the subject is extremely methodical and the arguments based on accumulated evidence are very convincing.

The bearing of climate on the changes in parent material culminating in the formation of colloid fractions possessing specific base exchange properties and definite H-ion concentrations has been discussed. The necessity for a detailed study of the colloid fractions from the various climatic regions as a means of understanding their origin has been stressed.

The last two chapters which are of special value to the Palestine agriculturists, are not without interest to the Pedologists elsewhere. Particular attention has been drawn to the importance of selection of soil for citrus culture, the quality of irrigation water and the tolerance limit of citrus plants to chloride. Incidentally, the changes that are likely to occur in the absorption complex are discussed with reference to the quality of the water and soils in Palestine. The nature of the changes indicated, will serve as cautionary examples for the development of future new projects. The last chapter is devoted to a description of the Zionist colonisation and its influence on the advancement of Palestine agriculture.

C. V. R.

Geschichte der Botanik von den ersten Anfängen bis zur Gegenwart. By M. Möbius, Emeritus Professor of Botany, Frankfurt, Germany. First Edition. (Gustav Fischer, Jena.) Pp. 458. Price RM. 20.

The ordinary University student is usually so busy with the memorisation of facts and figures that he scarcely gets the opportunity of devoting some time to the history of his science and often goes with a very inadequate perspective of the relative value of the results achieved by the numerous investigators, who have contributed their share to the development of the subject.

While there are several good books dealing with the history and growth of the science of chemistry, botanists have not been so fortunate in this respect. Moreover, the few books that we do have on the subject deal only with the events up to the close of the last century and no further. For this reason, the text by Prof. Möbius fulfils a long-felt want and is therefore warmly welcomed. As the author mentions in the Preface, he began his study of Botany in 1880, at a time when nothing was known of Mendelism and the fertilisation of the egg in seed plants was supposed to be caused by some substance diffusing out of the pollen tubes! Having been an eye-witness to the great changes and advances that have taken place through a period of more than 50 years, he is extremely well fitted to write on the subject with confidence and authority.

The arrangement of the material is under the various groups and subgroups of the plant kingdom. Portraits of the principal actors in the drama would have greatly enlivened the interest of the reader, but could not be included since this would

have increased the cost to a prohibitive figure.

No two persons will agree as to what more should have been included in the book and what might reasonably have been omitted or greatly condensed. The late Sir J. C. Bose is the only Indian botanist who has attracted the notice of the author. As is natural, though improper, German workers have been given more prominence than others.

While the book is valuable, it seems that the manuscript was not revised with sufficient care. Several errors and omissions have crept in and a few are of a fairly serious nature. Also one misses that personal touch which the author could easily have given about the lives of at least such of the men with whom he came in contact during his 50 years of botanical activity.

Such criticism, as I have made, is however not inconsistent with an expression of gratitude to Prof. Möbius for the service that he has rendered to botanical science.

P. MAHESHWARI.

Text-Book of Organic Chemistry. By George Holmes Richter. (Chapman & Hall, Limited, London; John Wiley & Sons, Inc., New York), 1938. Pp. viii + 711. Price 20*s*. net.

This book is intended to be a comprehensive introduction to the subject of organic chemistry presented for the needs of the beginning student. No doubt the author has been successful, as it is a well-known fact that many students find organic chemistry a difficult branch on their first acquaintance with it. It should come in helpful in providing a course in the subject though one may be ill-advised to confine reading, to this or any other single textbook as the descriptive and experimental material here has been limited to a minimum and its use will require to be supplemented. The historical background of the science is only briefly referred to, thus greatly diminishing the associated human interest. The author has sought to present the principles and conceptions of organic chemistry in a clear manner in the hope of giving the student a foundation which will enable him to take advantage of his further studies. A very appropriate account of keto-enol tautomerism and unsaturation have been given. Considering the pre-occupation of organic chemists with naturally occurring substances some of the groups have been ably dealt with, while the treatment accorded to colouring matters, terpenes, resins, gums appears somewhat inadequate. A brief reference could have been made to Raman effect, dipole moment, etc., which are becoming so important in organic chemistry. There is no intermingling of aromatic and aliphatic compounds as has been attempted in some recent books. The Geneva system is referred to in the naming of compounds; ketene however should be keten as -ene denotes unsaturated hydrocarbon. A long list of useful review and study questions follow at the end of every chapter, related facts being summarised often in convenient tables. A word of praise is due to the excellent printing and get-up of the publication with few typographical errors. The author has given us a lucid and interesting account of organic chemistry.

B. S. R.

The Behaviour of Animals. (An Introduction to its Study.) By E. S. Russell, D.Sc., F.L.S. (Edward Arnold & Co., London), 1938. Pp. xix + 196. Price 10*s*. 6*d*. net.

The behaviour of animals in their natural homes and surroundings has a perennial interest to man, and any work which deals with this subject in a simple and straightforward way will be welcome to students of natural science and others interested in animals. There must always be scientists who will not rest satisfied with the normal every-day activities of animals in their isolated state or in their communal life, but needs must test and measure their intelligence, plot out graphs and arrive at I. Q. for each animal and then grade up the standards with reference to their cortical development. Experimental studies have undoubtedly a great value in the interpretation of certain tricks which animals can be taught to execute, but they demonstrate the educability, the power of memory, and readiness to reaction on the part of animals which, when caged and presented with an array of observers and their apparatus, cannot be expected to behave normally. What the experimental results indicate must in the first instance be expressions of panic and confusion, and later mechanical repetitions. If the results of public examinations

can be depended upon as furnishing a correct and faithful account of the whole personality of the candidates, then surely we have in the experimental works of psychologists a complete picture of the intellectual life of animals. A knowledge of the behaviour of animals under special conditions, ingeniously devised to confuse them, has its own professional uses, but the knowledge accumulated by game keepers, shepherds, animal breeders, sportsmen and fishermen, unadorned by imaginative glow, must make a stronger appeal and perhaps possess intrinsically greater merit, as being a true record of normal animal life.

This book is a splendid compromise. Experimental biologists will find it both profitable and satisfactory. Students at the threshold of zoological studies will find it most stimulating. Advanced students, wishing for fuller information than is contained in the book, are provided with a bibliography at the end of each chapter. The illustrations, though few, are entertaining. What is most charming about the whole book is the simple and colourful language from which the author does not deviate even when he has to deal with the philosophical aspects of experimental studies. The book is based on the lectures delivered by the author in the Department of Zoology and Comparative Anatomy at University College, London, in 1933, and in their adaptation, they have lost none of the original interest and charm of exposition.

Lexicon de stratigraphie, Vol. I, Africa. Edited by S. H. Haughton. (Thomas Murby & Co., London), 1938. Pp. 432. Price 31*s.* 6*d.*

The Fifteenth International Geological Congress, held in South Africa in 1929, constituted a Committee for the preparation of a stratigraphic lexicon for the whole world, each continent to have a volume. The first fruits of this project is the present volume in handy size, dealing with the Continent of Africa, under the editorship of the Director of the South African Geological Survey, with the collaboration of prominent geologists familiar with different parts of the continent. The considerable amount of geological work which has been accomplished in Africa, especially during the present century, is reflected in this volume. Apparently the whole of the continent is covered except Mozambique and perhaps Rio de Oro.

In this volume the stratigraphic terms in use in Africa are arranged alphabetically irrespective of their geographic restriction. The notes are in English, French, or Italian, as used by the particular collaborator concerned. An extraordinary amount of information on the stratigraphy of Africa is thus made available for the use of geologists all over the world. In the words of the general editor, "As far as possible, each definition incorporates the original status of the term defined, the changes that have taken place in its meaning, the present-day usage, the geological relationships and geographical distribution within the continent of the term defined, a list of the chief fossils characteristic of the unit, and references to the most important literature." The index which occupies 12 pages at the end, has a geographical basis, each political division of the continent being arranged alphabetically. Under each country, the stratigraphic terms in local use are similarly arranged. The usefulness of such a publication for anyone interested in any aspect of African geology—stratigraphic, palæontologic or economic—is evident.

We have in India a similar publication in the *Indian Geological Terminology* by Holland and Tipper, which is familiar to all working geologists. The editor and the 22 collaborators of the volume under review deserve the congratulations and gratitude of all geologists for making this wealth of information of Africa available in a compendious form. The other volumes of this series will be awaited with considerable interest.

The book is well-printed and got-up but appears to be priced too high to become popular with a large circle of users. This aspect, it is hoped, will be remembered by the publishers in bringing out the other volumes of the series.

M. S. K.

Spawning of *Hilsa*.*

THE Indian Shad or *Hilsa* has long been favourably regarded as one of the most valuable Indian fish; it is a fish of good appearance and taste, is widely distributed in the Province of Bengal and adjacent waters, is found nearly all the year round and in sufficient quantity to be the occasion of an important fishery.

Consequently it is an object of interest not only to professional zoologists but to the general public as well.

When we consider that its life-history has been wrapped in the mystery we have all the ingredients of a first-calss subject for investigation and this has been clearly recognised by all those who have taken part in the investigation of Indian fish and fisheries since the time of the late Sir. K. G. Gupta.

The *Hilsa* has long been regarded as an anadromous fish, that is, one which moves up the rivers from the sea or estuaries in order to spawn. Until the recent discoveries of Dr. Hora, which are described in the paper under review, practically nothing definite was known of the spawning habits and grounds of the *Hilsa*, though there was naturally much guess-work.

There is a considerable difference in the habits of those anadromous fish whose life-history is well known. Such as the various eels, the salmon, sea-trout, smelt and European Shads.

Even two members of the same family, such as the salmon and smelt are very different in their habits. The salmon goes up rivers as far as ever it can in order to spawn; and smelt on the other hand, spawns at or about the place which is reached by the tide. Having spawned the smelt does not go further up the river.

There are two species of European Shad; the Allice Shad and the Twaite Shad. The Allice Shad goes a long way up the rivers to spawn, in the case of the Rhine as far as Switzerland; the Twaite Shad on the other hand, hardly wanders beyond the tidal influence where it also spawns. We know that the *Hilsa* goes a long way up the Ganges and is caught in the Son as far up as Dehri.

The late Sir K. G. Gupta and the late Dr. B. L. Chaudhuri made extensive tours and inquiries in Bengal in the cold weather of 1906–07 and devoted a lot of time to the *Hilsa*. As a result it was established that while *Hilsa* of marketable size could be obtained at some place or another practically at any time of the year, the young or small fish were practically unknown. Mr. K. C. De in his report on the *Fisheries of Eastern Bengal and Assam*, says: "The *Hilsa* is found in the sea and in all the principal rivers, at practically all times of the year."

The fact that no small *Hilsa* are caught in certain places is no proof they are not there since the meshes of the nets used by the fisherman may be too large to catch such small fish.

Even to-day it would probably be worth while to go over the notes made by Sir K. G. Gupta and Dr. Chaudhuri, but so far as one knows never published (for the period September 1906 to March 1907).

As a rule the fishermen say they have never seen the fry of the *Hilsa*, *e.g.*, at Kalagachia "We have not found any *hilsa* fry in the beels or rivers and I do not know where the *hilsa* spawn" and again at Hooghly "Have never seen *hilsa* ova anywhere or very young fry. *Hilsa* is always caught in deep water along the main current and never in shallow water."

On the other hand, the leading fisherman at Bangoan (Jessore) said, "We catch *hilsa* here in Jaishta and Ashar, but very seldom. We have occasionally seen *hilsa* fry 2″ long, coming up in Jaishta and going down in Bhadra."

In spite of investigations made by several scientists no step forward was made until Dr. Hora discovered large numbers of very small *Hilsa*, obviously quite young larvæ, in the Calcutta Corporation Waterworks at Pulta. The results of Dr. Hora's investigations are given in the paper reviewed here.

In view of Dr. Hora's discovery of young fry of *Hilsa* both at Pulta and subsequently at Nawabgunge it is certainly remarkable that previous scientists left Calcutta to wander all over the Province to search unsuccessfully for what has now been found at their very doors. But this discovery does not exclude, as Dr. Hora will be the first to admit, that there may be other spawning grounds of the *Hilsa* further up the rivers and more remote from the sea.

* "A Preliminary Note on the Spawning Grounds and Bionomics of the so-called Indian Shad, *Hilsa ilisha* (Hamilton) in the River Ganges," by Sunder Lal Hora, *Records Indian Museum*, 1938, **40**, Pt. II, 147–58.

We know that another Clupeoid, the herring itself, spawns under widely different conditions. The writer has observed the herring spawning in the fresh water of the river Schlei in Schleswig (Germany) and even in an arm cut off from a bay, in which the water has become quite fresh. On the other hand the same species, but may be a different race, spawns in deep and very salt water off the west coast of the British Isles.

As a result of Dr. Hora's discoveries a further question arises. Why does the *Hilsa* migrate up the Ganges as far as Bhagalpur and Monghyr and even up the Son to Dehri? Is this migration for food and is it entirely disassociated from the act of spawning? Or is it essentially a spawning migration?

Is it possible that there are two, or more, races or varieties of *Hilsa*, with different spawning grounds and habits? The fishermen can easily distinguish the male *Hilsa* (called *pait-hilsa* in Eastern Bengal) from the females which they brought to the writer when asked for " Unda-wallahs ".

Dr. Hora calls his paper a " Preliminary Note ", rightly so in our opinion, since it is to be hoped and expected that we may look for further papers on this most interesting problem, which he has already done so much to elucidate.

Another point to be cleared up is what is really the fish known to the fishermen as *Jatka* or *Jatkya*? According to Mr. K. C. De the *Jatkya* is the smallest of the herring family (*Clupea fimbriata*) and is found in the estuaries as high up as Goalundo from February to April. It is a pretty fish with a rather dark back and silvery sides shot with gold. From the similarity in shape, appearance and taste, the fishermen describe it as the young of the *Hilsa*.

According to Mr. Finlow, " The fingerling of the *Hilsa* has been identified as the *Jatka*, a small fish less than 6″ long, found in the Buriganga, Lakhya and Meghna rivers in Eastern Bengal in February–March."

Now that the first and most difficult step has been taken by Dr. Hora in elucidating the mystery of the spawning of the *Hilsa* we await further discoveries in the near future and in particular the eggs and first larval stages.

In conclusion, the reviewer would fail in his duty if he omitted to congratulate Dr. Hora on the appearance of one of the most valuable and interesting, if not *the* most valuable and interesting, paper on Indian fish published for many years.

J. Travis Jenkins.

CENTENARIES

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Gregory, James (1638-1675)

JAMES GREGORY, an eminent Scottish mathematician, was born in a parish near Aberdeen in November 1638. The Gregory family had produced many persons who distinguished themselves in science. James was the first and most eminent among them. In the next generation his own son was professor of physics and three of the thirty-two children of his brother David were good mathematicians. James' education began at the grammar school of Aberdeen and was completed at Merischal College. His scientific talent was discovered and encouraged by his elder brother David. From 1664 to 1667 he studied mathematics at Padua.

His Career

On his return to England in 1668 Gregory was elected a fellow of the Royal Society. Late in the same year he was appointed professor of mathematics in the University of St. Andrews. In 1674 he accepted the mathematics chair of the University of Edinburgh. He was the first " separate professor of mathematics, exclusively devoted to his subject, and not called upon to go through the drudgery of regenting...... (and) only required to give two public lectures a week to such students as wished to attend."

His Contributions

James Gregory was an inventor of the first order. The reflecting telescope universally employed in the eighteenth century, was first described in his *Optica promota* (1663). His chief mathematical contributions relate to (1) quadrature of circle and hyperbola, (2) use of convergent series to calculate logarithms and to find lengths of

curves, (3) Mercator's chart, (4) solution of the Keplerian problem and (5) geometrical methods for drawing tangents to curves. His brother David strongly urged him to publish his results on quadrature. But he very generously refused to do so on the ground that, as he had been led to it by Newton's discovery, he was bound in honour to wait till Newton should publish his.

Vera Circuli et hyperbolae quadratura (1667), *Geometriae pars universalis* (1668) and *Exercitationes geometricae* (1668) were his works.

His End

Gregory has been described as a man of very acute and penetrating genius, though of an irritable temper. He was devoid of ambition but was keenly sensitive to criticism. One night in October 1675, while showing Jupiter's satellites to his students, he was struck blind by an attack of ameurosis, and died of apoplexy three days later.

Becket, William (1684-1738)

WILLIAM BECKET, a British surgeon and antiquary, was born at Abingdon in 1684. He was elected a fellow of the Royal Society in 1718 and read three papers on the *Antiquity of the venereal disease*. He was also an original member of the Society of Antiquaries, which was virtually established in 1717. He was for some years surgeon to St. Thomas's Hospital, Southwork.

His works are: (1) *New discoveries relating to the cure of cancers* (1711–1712); (2) *An enquiry into the antiquity and efficacy of touching for the king's evil* (1722); (3) *Practical Surgery, illustrated and improved, with remarks on the most remarkable cases, cures and discussions in St. Thomas's Hospital* (1740) and (4) *A collection of chirurgical tracts* (1740).

Becket died at Abingdon, November 25, 1738.

Herschel, William (1738-1822)

WILLIAM HERSCHEL, a famous European astronomer, was born at Hanover, November 15, 1738. He was a son of a musician. His father brought him up to his own profession with four other of his sons. He came to England sometime between 1757 and 1759 and during this period it is said that his philosophical tastes were so strong that he spent all his pay on a copy of Locke's *On the human understanding.*

Turns to Mathematics

About 1766 when Herschel was organist of a Chapel at Bath, he "resolved to place all his future enjoyment" in the pursuit of knowledge and turned his attention to mathematics. "After fourteen to sixteen hours' teaching he was won't to unbend his mind with Maclaurin's *Fluxions*. Smith's *Optics* and Fergusson's *Astronomy* were the companions of his pillow and inspired his resolution to take nothing upon trust."

His Contributions

After two hundred partial failures Herschel made his own telescope of five feet focal length and began his famous observations which have been recorded in the *Philosophical transactions* of the Royal Society in a series of about 69 papers, the first of which was published in 1780 under the title *Astronomical observations on the periodical star in Collo Ceti.* His last paper which was *On the places of* 145 *new double stars*, was published in the first volume of the *Memoirs* of the Astronomical Society (1822). Herschel must be remembered by the number of bodies which he added to the solar system. Including Halley's Comet and the four satellites of Jupiter and five of Saturn, the number previously known was eighteen; to which he added nine, namely Uranus (1781) and six satellites and two satellites to Saturn. His announcement of the motions of binary stars, his discovery of the proper motion of stars (1783) and his speculations on the Milky Way and the constitution of nebulæ first opened the road to other systems in the universe. He was the virtual founder of sidereal science and his only rival in exploring the heavens was his son. He also made telescopes for most of the European Observatories.

His Absorption in Work

He had his telescope set in his own garden. During intervals of a concert he would run, still in lace ruffles and powder, from the theatre to the workshop. He would polish his mirror continuously for sixteen hours and more. He is stated to have once worked and observed without rest during three days and nights, sleeping at the end for twenty-six hours at a stretch. Miss Burney describes him as "a man

without a wish that has its object in the terrestrial globe, perfectly unassuming (yet) openly happy in his success."

HIS HONOURS

His discovery of Uranus won him the Copley Medal and Fellowship of the Royal Society. It also brought him to the notice of the king who appointed him court astronomer with a salary of £ 200 a year. In 1786 he was elected a fellow of the Royal Society of Gottingen. The King of Poland sent him his portrait. His place became a place of pilgrimage for scientists, princes and grand dukes without number. Academic honours came from many universities and learned bodies. He was created a knight in 1816.

In his eighty-fourth year, Herschel died of bilious fever on August 25, 1822.

ASTRONOMICAL NOTES.

Planets during December 1938.—Venus is a morning star and will be a bright object visible in the eastern sky for about two hours before sunrise. On December 26, it attains greatest brilliancy, the stellar magnitude at the time being $-4 \cdot 4$. Mars is gradually getting brighter and can be seen as a star of the first magnitude, rising about two and a half hours after midnight; it will be in the constellation Libra at the end of the month.

Jupiter will continue to be visible in the western sky in the early part of the night. So also will be Saturn which will be on the meridian at about sunset. On December 15, the planet will be stationary as seen from the earth. The ring ellipse is still nearly edgeways, the dimensions of the major and minor axes being $41 \cdot 6''$ and $5 \cdot 9''$ respectively. Uranus is slowly moving westwards in the constellation Aries and observers with a binocular can easily locate the planet about a degree north of the fifth magnitude star σ Arietis. The following close conjunctions of the Moon with planets will occur during the month—on December 5, Uranus; on December 17, Mars; December 18, Venus; and December 20, Mercury.

Jupiter's Satellites X and XI.—Since discovery, further observations of the two new satellites of Jupiter have been made at Mount Wilson. From the first five positions obtained, Dr. Paul Herget of Cincinnati has computed two orbits for satellites X, one assuming a retrograde motion for the satellite and the other a direct one. He states that the later observations, however, do not appear to confirm the retrograde orbit. Dr. R. H. Wilson has calculated an orbit (U.A.I. circ 728) with eccentricity $0 \cdot 14$ and period $254 \cdot 21$ days. The elements of the direct orbit are similar to those of the sixth and seventh satellites of Jupiter.

A Faint Star with Large Proper Motion.—In the course of the survey for proper motions of faint stars at the Nizamiah Observatory, the star Hyd.ph, $-18° \cdot 9743$ has been found to have a motion of nearly one and a half seconds of arc per annum. The star is of the twelfth magnitude (photographic scale) and the position $(1900 \cdot 0)$ is given by R. A. $5^h\ 4^m\ 7^s$, Declination $18°15' \cdot 7 \cdot$S The star is probably a dwarf and one of the nearest neighbours of the Sun.

T. P. B.

OBITUARY.

N. G. Majumdar.

WE regret to record the death of Mr. N. G. Majumdar, Superintendent of the Archæological Section of the Indian Museum, under very tragic circumstances. He was murdered by dacoits on the night of 10th November 1938, at Johi, in the district of Dadu, Sind, where he was camping in connection with an explorative survey of the hilly country, northward of Manchur Lake.

Mr. Majumdar was a brilliant graduate of the Calcutta University. After taking his M.A. in 1920, he took up the study of Archæology under Sir John Marshall. He carried out extensive excavations in southern Sind. He was reputed to be one of the best archæologists of India and his untimely death has brought to a close, a very promising career.

RESEARCH ITEMS.

Theory of Topological Transformation.—Dehn (*Acta. Math.*, **B. 69**, pp. 137–206) has made important contributions to the theory of the determination of the group of classes of topological transformation of any 2-dimensional surface into itself. A class of such transformations consists of all those which can be obtained from any one of them by a continuous deformation, *i.e.*, two transformations of the same class can be homotopically transformed into each other. Such problems are already known to be extremely difficult and complicated and hitherto only solutions of some particular problems are known, *e.g.*, a sphere with one hole has only the unit class of transformations. In the case of the anchor ring the group consists of all transformations of the type $\begin{vmatrix} a & b \\ c & d \end{vmatrix}$ where $ad - bc = 1$, a, b, c, d being integers. The central idea of Dehn's work consists firstly in studying the effect of a topological transformation on certain system of curves and associating certain number systems for the curve systems and then studying the effect of the transformation on them. The curve systems which he considers here are essentially distinct from those which come into play in defining the fundamental group. In the former case the curves are free from singularites whereas it is not so for the other. For the latter purpose it is enough if we consider curves passing through a certain point and having a certain direction. The method adopted here seems particularly suited to 2-dimensional manifolds; and the problem of determining the group is reduced to an arithmetical problem. The groups are all shown to be generated by a finite number of elements. Some of the results are given below.

(1) The group of the transformation classes of the anchor ring with one hole is generated by S and T with the defining relation $S^3T^2 = 1$. ∴ it is isomorphic with the fundamental groups of the clover-hoof-knot (*i.e.*, of the outer space of the knot).

(2) For L_4, the sphere with four holes, it is the free group with two generating elements.

(3) For the closed surface of deficiency p, the group of transformation classes is generated by means of $2p\ (p-1)$ special transformations. These special transformation classes are analogous to the following. Consider L_2, *i.e.*, the annular space between two circles C_i and C_o. Let I and O be two points on them. Let I_o be joined by two curves v and v' in the region one of which is the straight line, the second is one which does not meet v' except at I and O and where the region formed by v and v' includes the inner circle C_i. Then it is easy to give a transformation which is non-homotop with the identical transformation which carries over $v \rightarrow v'$. Such a transformation can be termed as a screw transformation round C_i. The special transformations met with are analogous to these.

We await the further progress of Dehn's work with interest. K. V. I.

* * *

Active Carbon from Bituminous Coal.—A paper describing the investigation carried out jointly by the Fuel Research organisation of the Department of Scientific and Industrial Research and the Chemical Defence Research Department, into the possibility of producing from lump coal an active carbon suitable for use in gas respirators has recently been issued (H.M. Stationery Office, 1938—Technical Paper No. 47).

During recent years the consumption of active carbon in industry has increased markedly, its main uses being in connection with the purification of solutions and in the recovery of solvents in manufacturing processes such as the production of rubber articles, where solvents are used in large quantities. A large proportion of this carbon is imported, and it was realised that, if a satisfactory means could be found for its production from lump coal, the application of the process would be of benefit to British industry.

The present paper describes the stages in the investigation, which was developed from small-scale experiments to work on a full commercial scale. The results show how at least one type of active carbon of the highest quality can be made, and there is sufficient promise in the preparation of other types to justify further research.

* * *

Recent Work on Moisture in Wood.—New ways of using wood as a raw material of industry have shown the need for further knowledge of its fundamental colloidal properties. A recent Report issued by H. M. Stationery Office, London (1938, Price 10 *d.*) deals with the affinity of wood for moisture and the dependence of its strength properties and dimensions on the humidity of the atmosphere. The results of experiments, which are described, are used to build up a rational theory of shrinkage which yields a quantitative connection between the shrinkage or swelling of wood and the swelling pressure acting on the material. As a result, it is shown that the resistance of wood to shrinkage forces is practically identical with its resistance to external loads.

* * *

Anatomy of *Dermophis*.—The genus *Dermophis* (Apoda; Amphibia) has a curious distribution; *D. mexicanus* occurring in America and *D. gregorii* in Africa. A comparison of the cranial nerves and blood vessels of the two forms has been made by E. F. J. de Jager (*Anat. Anz.*, **Bd. 86**, p. 321, 1938) with a view to determine the generic status of these two species since it is improbable at first sight that two allied species of the same genus would have such a discontinuous distribution. This comparison has yielded interesting results. The two species so far as their cranial nerves and blood vessels are concerned, reveal very striking similarities and only very inconspicuous differences. The ganglia of the V and VII nerves as well as the nerves themselves show

similarities. The ridge-like branch of *Vb* present in both, the anastomosis between the chorda tympani and the *Vc*, are amongst the more interesting points of resemblance. Similarities in the cranial blood vessels are also seen, the most important among which is the presence in the cranio-quadrate passage of a large venous channel formed by V. jugularis interna, the V. capitis lateralis and the cranial branches of the latter.

The Treatment and Prophylaxis of Malaria.*

A Comparative Study of Quinine as compared with the Synthetic Drugs Atebrin and Plasmoquine.

A SERIES of experiments in accordance with a uniform programme under the auspices of the League of Nations have been conducted in different countries under varying epidemiological conditions to study the comparative value of quinine as against Atebrin and Plasmoquine. The study included the relative value of these three drugs in respect of (1) primary infection, (2) gametocytes, (3) acute clinical symptoms, (4) frequency of relapses, (5) splenomegaly and prophylaxis. The tests on prophylaxis included (1) a daily administration of a prophylactic dose of quinine or atebrin to the entire population of an antimalarious district throughout the effective transmission season; (2) the systematic treatment with either one or other of the drugs alone or in combination with plasmoquine of all clinical cases of malaria whether primary or relapses detected during the season; and (3) medical and microbiological observations of the above groups and of a control group until the following transmission season.

As a result of these experiments one of the important observations made is that the differences existing between the strains of parasites, prevent the drawing of uniform conclusions. But still from the available evidence it is possible to state that quinine in mean daily doses of 1 gm. for five to seven days compares quite favourably with atebrin, though the action of atebrin is slightly more rapid and more lasting on the trophozoites of *P. vivax* and *P. malariæ*. The atebrin-treated cases have fewer relapses than the quinine group though the yellow colouration produced by atebrin is a definite disadvantage.

The selective anti-gametocidal action of plasmoquine against the gametocytes of *P. falciparum* is confirmed and no further evidence is available to justify its therapeutic use.

In combination, the value of quinine and atebrin is still doubtful, but quinine and plasmoquine offers distinct advantages in having fewer and less intense toxic symptoms as also being found most efficacious in the treatment of benign, tertian and quarten malaria.

It is noted that while the possible toxic effects of the synthetic drugs have been studied in detail, the question of the behaviour of quinine under similar conditions has not received the same attention. The slow elimination of atebrin is confirmed and the experiments of Field, Niven and Hodgkin further show that the quantity of atebrin held in the system after the third week, after the cessation of prophylactic treatment (in weekly doses of 0·40 gm.) was too low to prevent the occurrence of relapses.

Further work on the dosage and form of treatment and administration of atebrin and plasmoquine to children in any scheme for mass treatment. is called forth in view of the statement in the League report that these questions cannot be regarded as finally settled.

In the doses used as a prophylactic (0·1 to 0·40 gm. of quinine daily as against 25 mg. every two days to 5 cg. every day of atebrin), it is reported that quinine was more effective than atebrin as the reduction in the spleen and parasite rates in the quinine group was effected more quickly and maintained for a longer time. But attention has to be drawn to the fact that while the quinine group received 2/5 of the usual curative dose, the atebrin group got only 1/6 of the daily curative dose and that atebrin was administered only once in two days as against quinine which was given daily. With equivalent quantities the results might have been very different. In the case of plasmoquine it is felt that except under strict medical control, the drug is still dangerous for use as a mass prophylactic.

As regards the rôle of synthetic drugs in regard to black water fever, it is stated that the action of atebrin in influencing the onset of black water fever is probably the same as that of quinine.

B. ANANTHASWAMY RAO.

* *Fourth General Report of the Malaria Commission*, "Study of Synthetic Drugs as compared with Quinine, in the Therapeutics and Prophylaxis of Malaria."

League of Nations Bulletin of the Health Organisation, October 1937—"Comparative Experiments in Mass Prophylaxis of Malaria by means of Quinine and of Synthetic Drugs (Quinacrine and Præquine)" by L. Parrot, A. Catanei and R. Ambialet with the co-operation of J. Glastrier.

Prevention and Treatment of Malaria by Synthetic Drugs (Field Experiments) by Dr. E. Mosna and Dr. A. Cannalis under the direction of Professor G. Bastianelli.

SCIENCE NOTES.

Chemical Investigation of the Seeds of *Swietenia Mahagoni*.—Dr. S. V. Shaw and Mr. D. G. Pishawikar, Department of Chemistry, Rajaram College, Kolhapur, write under date September 25, 1938 :—

The fruits for this investigation were obtained from a few trees planted in the local Town Hall gardens. The tree growing to a height of 45 feet appears to be *Swietenia Mahagoni* which is not indigenous to India but is stated to grow abundantly in West Indies and Central America. Each fruit yields 55–60 seeds which are winged at the top and brown in colour. The upper soft fleshy cover of the seeds was removed and the seeds were extracted with petroleum ether. A white substance observed in the petrol solution remained dissolved in the oil after removal of the petroleum ether and the *yellow oil* obtained had an unpleasant and bitter taste. The table below gives the analytical data for the oil side by side with the values quoted by Lewkowitsch and Warburton (*Chemical Technology and Analysis of Oils, Fats and Waxes*, 1922, **2**, 147) for a sample received at the Imperial Institute from Barbados. The latter is described to be a *dark greenish oil* having an unpleasant bitter taste and exhibiting weak drying properties.

	Authors	Lewkowitsch
Yield (calc. on weight of seeds)	50 per cent.	
$d^{27\cdot5}_{27\cdot5}$	0·9179	$d^{15\cdot5}_{15\cdot5}$ 0·935
n^{25}	1·4720	
Acid value	1·25	13·0
Saponification value ..	201·3	193·3
Acetyl value	21·8	
Reichert-Meisel value ..	2·30	1·9
Polenski number ..	0·35	
Iodine value	94·4	125·0
Unsaponifiable matter ..	1·8	
Titre test	..	30·5

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Fungi of India.—A supplement to Butler and Bisby's *Fungi of India*, recording more than 500 new fungi which have been discovered and described since 1930 by mycological workers in India, has recently been issued (B. B. Mundkur : Scientific Monograph No. 12, The Imperial Council of Agricultural Research ; Manager of Publications, New Delhi, 1938 ; Pp. 54 ; Price Re. 1–6–0 or 2*s*. 3*d*.). There has been an increasing amount of activity in this field, thanks to the participation of many of the Indian Universities. Dr. Mundkur's book is a valuable record of reference whose usefulness would have been greatly enhanced if it had been possible to mention the source of supply for each of the cultures recorded.

Fungi have great economic importance and the potentialities of their employment in industry have not been explored in India. It is imperative that a National Collection of Type Cultures, should be organised as a first step in stimulating intensive research in industrial mycology. Dr. Mundkur's volume is helpful in inviting attention to the wealth of mycological material in which the country abounds, and to the necessity for maintaining a national collection of cultures as already suggested in *Current Science* for May 1938 (Vol. 6, No. 11). M. S.

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The Recent Government Report on the **Quetta Earthquake of 31st May 1935** by Captain L. A. G. Pinhey, Additional Political Agent, Quetta, gives an authoritative and complete account of the action taken by the authorities immediately after the earthquake, for relieving the distress and suffering of the survivors, and later, towards the gradual reconstruction and repopulation of the City of Quetta. Among the major problems which one has to face immediately after a disastrous earthquake of the kind which occurred in Quetta, we may mention the rescue of those who are buried under the debris and are still alive, the establishing of communications with the outside world, the provision of shelter, food and medical attention to the survivors, and the preventing of looting by irresponsible people in the affected area. The Report under review gives an account of the work done in these and several other directions, and bears eloquent testimony to the remarkably expeditious and efficient manner in which the different relief operations were organised and conducted. The detailed information given in each case of how exactly the authorities tackled their problems and went about organising this relief work will, we have no doubt, be of great value some day when one may be called upon to deal with a similar situation elsewhere.

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Researches at Rothamsted.—There is probably no other science which bristles with so many controversial differences of opinion as agriculture. This is undoubtedly due to the very large number of variable factors which go to raise a crop ; and the unravelling and discernment of the individual effect due to any single factor is possible, in several cases, only by exhaustive statistical analysis of systematic data collected over a period of several decades. The value of the data is greatly augmented by the continuity of the original lay-out of the experiment and fidelity of the replications year by year. The unique success of the Rothamsted Experimental Station in achieving this object—especially in their well-known long term experiments—has been mainly due to the relative permanence of its Staff, several of whom have spent decades in the service of the Institute ; and one agrees with the note of caution sounded by the Director in the *Annual Report* of the Station for 1937, which has recently

been published, when he regrets the loss of a number of valuable members of the Staff during the year and observes that "serious consideration should be given to the avoidance of too great a rate of change".

An interesting feature of the present Report is the prominence given in the opening paragraphs to a discussion of the objectives which an Experimental Station such as Rothamsted should keep in view, in relation to the national agricultural economy of the country in which it is situated. Though the area under arable crops and the total number of workers on land, in England and Wales, have shown considerable decreases within the last 20 years (amounting to about 25%), the total value of agricultural output rose from £141·7 million in 1925 for 803,000 workers to £170·7 million in 1936 for 641,000 workers. This increased efficiency of the farmer and worker has been mainly due to the work of Agricultural Stations in England and Wales—chiefly the one at Rothamsted. The work of this station is winning increased recognition at the hands of Government and public alike, and the present year's developments include the erection of new and bigger laboratories to cope with the increased work in the chemical departments, at a cost of £30,000, of which sum half has been promised by Government.

The Station has already chalked out a tentative scheme for the celebration of its Centenary in 1943 and has set before itself the ambitious programme of giving financial stability to the work of its various departments, by collection of permanent endowments to the tune of £125,000. The unique value of the Station's work is fast making it a National Trust and the appeal will no doubt meet with the same quick response as what greeted the previous one for £60,000 in 1934. C. N. ACHARYA.

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London Scientific Film Society.—*Chemistry and Industry* (October 1st, p. 918) reports the formation of a Scientific Film Society in London. This Society proposes to give a series of shows of good films on scientific themes to its members and their guests in the first instance. To achieve this purpose, the Society will foster the production of films, which will be instructive of the phenomena in scientific research as cannot be otherwise ordinarily be understood and more especially of the interrelation between science and technology and their impact on modern society. An animated cartoon on the operation of the internal combustion engine, another illustrating a mathematical differential equation, a biological film on the paramecium, an engineering film illustrating the boring for oil and a film illustrative of how electrical and other communications have broken down natural barriers, are a few of the representative films included in the programme for the inaugural show in November. The show of films will be accompanied by appropriate lectures.

The Society has been formed on the recommendation of the Special Committee set up by the Association of Scientific Workers to enquire into the prospects of scientific documentary films. This Committee found that the few scientific films produced by the British Film Organisations had a great appeal on the audience.

Professors Sir Frederick Gowland Hopkins, Sir William Bragg and Professor L. Hogben and Julien Huxley are the distinguished patrons of the Society, which has on its rolls already about a hundred and fifty members.

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Insecticidal Plants.—The possibilities of cultivation of insecticidal plants in India and the manufacture of vegetable insecticides, are engaging the attention of the Industrial Section of the Botanical Survey of India. There is an increasing demand for insecticides from vegetable sources which are comparatively harmless to human beings, and are for this reason, preferred to the more dangerous arsenical and other chemical preparations. Among such insecticides mention may be made of "Tuba" root of commerce (Derris), Pyrethrum of commerce (*Chrysanthemum Cinerariefolium*) and Tobacco infusion, decoction, nicotine, nicotine sulphate, etc., produced from tobacco waste (*Nicotiana tabacum*). The roots of Derris and flowers of Pyrethrum are considered to be essential proprietory ingredients of insecticides used as dust or spray.

A number of species of Derris grow wild in India. The root of *Derris ferruginea* which occurs in Assam, is rich in Rotenone (nearly 3 per cent.) and shows possibilities for commercial exploitation (see this *Journal*, 1938, **7**, 22). Insecticides prepared from Derris have been tried with success against biting and sucking insects, against caterpillars which damage cabbage crops and against the mango leaf hopper. Attempts to cultivate the "Tuba" of commerce or *Derris elliptica* are being made at the Forest Research Institute, Dehra Dun, and by the agriculture departments of Travancore, Kashmir, Punjab and Mysore. Mysore imported "Tuba" from the Federated Malay States, 4 years ago and grew the plant successfully. Two-year old plants have yielded 5–7 per cent. rotenone.

Pyrethrum has been successfully grown in Murree in the Punjab in experimental plots and its cultivation may be easily extended to other parts of India where the climate and soil are favourable for its growth.

Other Indian plants which are reported to have insecticidal properties are : Kharina (*Milletia pachycarpa*); Pilavaram (*Mundulea suberosa*); Karanja (*Pongamia glabra*); Lashtia (*Tephrosia candida*); Neem (*Melia Azadirachta*); Madar (*Calotropis procera*), Turmeric (*Curcuma longa*) and *Polygonum flaccidum* and *P. assamicum*.

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Institute of Plant Industry, Indore.—Films on silage making, rain-watered compost, municipal compost and improved methods of sugarcane cultivation, have been prepared by the Institute of Plant Industry, Indore, for exhibition with a view to bringing home to the cultivators in the States of Central India and Rajaputana, the results of research and improvements in the science and practice of agriculture. The Institute has on its programme the preparation of films on the eradication of Kans, the working of the Indore Ridger, the standard process of making compost, the drying of cottonseed to prevent pink boll-worm and the making of bone char.

It will be recalled that in the report on the work of the Imperial Council of Agricultural Research (1937), Sir John Russell laid special emphasis on the urgent need for bridging the great gulf separating the Agricultural Experiment Stations and the cultivators. The exhibition of films bearing on improvements in agricultural operations can be of immense help in narrowing down the gap. The work of the Institute of Plant Industry to popularise the results of scientific research is worthy of emulation by other experiment stations.

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Royal Asiatic Society of Bengal.—At the ordinary monthly meeting of the Society held on 7th November, Mr. Johan van Manen read a paper on *Recent Exploration in Tibet.* It is of interest from time to time to review the advance of our knowledge concerning Tibet. "In the last decade exploration has been very active. Geographically the work done may be roughly grouped into exploration (1) in the West, mainly around Kashmir, (2) in the South, the great Himalayan peaks, (3) in the East, the Countries West of China, and (4) in Central Tibet, the few visits to Lhasa and other places. The exploration is chiefly of a geological, alpinistic, geographical, botanical, zoological, anthropological, linguistic or historical nature, according to the special interest of the travellers."

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Scientific Literature : Problems of Co-ordination.—At the Fourteenth International Conference on Documentation, held at Oxford on September 21–26, a paper on "The Co-ordination of Scientific Literature" was presented by Mr. J. Lewkowitsch.

The problem discussed was the vital present-day need of rendering available to the scientific worker, rapidly, completely, and in classified form, the scientific literature published by other workers. The framework of a complete scheme for the rationalisation of publication, abstracting and co-ordination of the literature was put forward as an ideal towards which to work. The chief suggestions were : (1) That the number of journals published (pure or applied science, or reviews) shall be limited by international agreement of societies and publishers, in regard to scientific recognition. (2) That these journals shall be the only recognised medium for research work, and that other journals shall not be abstracted. (3) That all authors shall prepare their own short abstracts, for the form of which the editors shall be responsible, and that the abstracts shall be sent by the editors to central organisations publishing classified abstracts (*Chemical Age*, October 1, 1938).

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Col. C. M. Thompson, I.A., Director, Survey of India, retired from service on September 21, 1938, on attaining the age of superannuation. Col. Thompson, an officer of versatile qualifications, had extensive experience in all branches of the work of the Survey ; he was a specialist in cadestral Survey, and knew many languages, including some of the Indian languages,

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The Nobel Prize for Physics for the year has been awarded to the famous Italian Scientist, Sgr. Eurico Fermi, Professor of Physics, Rome University for "the discovery of new elementary Radio-active substances engendered by the irradiation of Neutron" and other reactions caused by neutrons.

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The Lord President of the Council has appointed **Dr. G. Stafford Whitby,** at present Director of the Division of Chemistry, National Research Council, Canada, and formerly Professor of Chemistry at the McGill University, Montreal, to be the Director of the Chemical Research Laboratory, Teddington, in succession to Sir Gilbert Morgan, F.R.S., who retired on 30th September last.

Dr. Whitby is expected to take up his duties early in 1939.

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Prof. Karam Narayan Bahl, D.Sc. (Panj.), D.Phil. (Oxon.), F.R.A.S.B., F.N.I., Head of the Department of Zoology, University of Lucknow, has been awarded the D.Sc. degree by the University of Oxford, the highest distinction in Science in that University. Prof. Bahl is the first Indian to be so honoured. He is the foremost morphologist in India and holds an eminent position amongst the zoologists. He is the founder of the School of Zoology at the Lucknow University where morphological work has been done in almost every branch of Zoology. He has guided the research work of a number of students, amongst whom as many as seven have secured their doctorates from the University of Lucknow.

The *Indian Zoological Memoirs* series projected and edited by Dr. Bahl have laid the foundations of Indian Zoology and form an important landmark in the development of this branch of science in India.

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The **Noel Deer Gold Medal** for the year 1936, has been awarded to Mr. R. C. Srivastava and Dr. H. D. Sen in consideration of their report relating to large-scale experiments on the Treatment of Sugar Factory Affluents.

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Mr. K. S. Arnold has been appointed Professor of Sugar Engineering, Imperial Institute of Sugar Technology, Cawnpore.

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Dewan Bahadur Dr. A. Lakshmanaswamy Mudaliar, has been appointed Principal, Medical College, Madras.

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According to a United Press message, the Government of Bihar have decided to employ on salaries ranging from Rs. 250–300 per mensem, four Czechoslovakian Jews, in the Industries Department of the Government.

In a note printed in *Current Science* (1938, 7, 31), the desirability of employing qualified Jews, who have been expelled from Central Europe due to political reasons, was indicated. The above decision of the Government of Bihar is very much to be welcomed.

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University of Mysore.

I. *Personnel.*—Mr. J. C. Rollo, M.A., J.P., Principal, Maharaja's College, Mysore, who was granted combined leave, returned from leave and assumed charge of the office of Principal from Mr. A. R. Wadia on the 6th October 1938.

II. *Convocation.*—The Twenty-first Annual Convocation for conferring degrees was held on the 6th October 1938, His Highness the Chancellor, presiding. The Rev. C. F. Andrews delivered the Convocation Address.

III. *Extension Lectures.*—Dr. C. Minakshi, M.A., Ph.D., Madras. delivered a lecture in English at Mysore on " Some South Indian Bronzes " illustrated with lantern slides.

IV. *Deputation to Congress and Conferences.*—(1) Dr. M. H. Krishna, M.A., D.Litt., Professor of History, Maharaja's College, Mysore and Director of Archæological Researches in Mysore, was permitted to attend the Indian History Congress held at Allahabad on the 6th, 7th and 8th October 1938.

(2) Mr. V. Raghavendra Rao, M.A., B.T., Lecturer in History, Maharaja's College, Mysore, was deputed to attend the Historical Week celebrated at Kamshet (Dt. Poona) from the 2nd to the 8th October 1938.

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Andhra University.—The Degree of Master of Science Honours has been conferred on (1) Mr. Bhaskararama Murti for his thesis " Chemical Investigations of Indian Medicinal Plants ", (2) Mr. V. D. N. Sastri, for his thesis " Study of the reactivity of the double bond in some substituted coumarines and geometrical inversions in acetylated coumaric acids ".

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University of Madras.—The Degree of Master of Science has been conferred on (Miss) S. Pankajam in consideration of the thesis entitled " On some topics Connected with Boolean Algebra ".

* * *

Outfits for Absorption Spectrophotometry : (Photographic, Visual, Photo-electric).—Much valuable information can be deduced from the absorption curve of a substance and in modern practice this is an accepted method for many biological assays ; (blood serum, cerebro-spinal fluid, the vitamins, etc.), for the identification and measurement of organic substances, dyes, and other colouring matters of food substances, etc. With the introduction of the spekker ultra-violet spectrophotometer by Adam Hilger, Ltd., the technique of absorption spectrophotometry has been made very convenient, speedy and accurate. A recent pamphlet issued by Messrs. Adam Hilger Ltd., London, describes in a very elegant manner the various outfits placed by this firm on the market for (i) ultra-violet spectrophotometry; (ii) visual spectrophotometry and (iii) photo-electric methods of absorption measurements in the ultra-violet ; the pamphlet also serves as a useful guide to the choice of suitable apparatus for any purpose in view.

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Diffusion Pumps for the Production of High Vacua.—We have received a new catalogue of these pumps, of the all-metal type, from Messrs. W. Edwards & Co., the well-known firm of London. Mercury diffusion pumps provide the most satisfactory means of reaching very low pressures and even the smallest sizes have speeds at low pressures much greater than can be obtained by rotary pumps. Furthermore, they are extremely robust, have no moving parts to wear, and can be dismantled for cleaning with a minimum of trouble. The range of diffusion pumps and accessories described in this catalogue, will be found to cover almost all the requirements, from small-scale laboratory work to large-scale industrial processes, where the lowest possible pressures and highest pumping speeds are required. It should prove of interest to physicists, chemists, and works managers, in most industries.

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Announcements.

The Annual Conference of Medical Research Workers in India will be held in New Delhi from 12 to 17th December, under the auspices of the Indian Research Fund Association.

International Union of Geodesy and Geophysics.—The Seventh Meeting of the International Union will be held in Washington, D.C. between 4–16 September, 1939. This will be the first meeting of the Union outside Europe. The meeting will be divided into seven sections, including meteorology. Further details regarding the meeting can be had from Dr. John A. Fleming, General Secretary, American Geophysical Union, Department of Terrestrial Magnetism, 5241, Board Branch Road, N.W. Washington D.C.

Seventh International Botanical Congress.—The Seventh International Botanical Congress will be held in Stockholm, Sweden, on July 17-25, 1940.

The Congress will visit the botanical institutions of the University and the Swedish College of Agriculture at Uppsala in addition to several botanical institutions in and near Stockholm. Visits will also be paid to Lund (Botanical Institute) and Goteborg (Gothenburg Botanical Garden).

More detailed information may be obtained from the Secretary, Dr. C. R. Florin, Riksmuseum, Stockholm 50, Sweden.

The Tenth International Congress of Military Medicine and Pharmacy will be held in Washington D.C., from May 7–15, 1939. General Charles R. Reynolds, the Surgeon-General of the United States Army, will be the President of the Congress. Further details regarding the Congress can be had from the Secretary-General (Colonel Harold W. Jones), Army Medical Library, 7th Street and Independence Avenue, Southwest Washington, D.C., U.S.A.

International Acetylene Congress.—The Thirteenth International Congress of Carbide, Acetylene, Oxy-Acetylene Welding and Allied Industries will be held in Munich, Germany, from June 25 to July 1, 1939. The three preceding congresses were held in Zurich (1930), Rome (1934), and London (1936).

The purpose of the Congress is to promote and discuss all questions of scientific, technical and economic nature which are related to the preparation and uses of calcium carbide, of acetylene, and of the oxy-acetylene process.

Dr. Schmitz, Chairman of the Board of Directors of I.G. Farbenindustrie, will preside at the Congress. Official inquiries should be directed to the Office of the Congress in Berlin-Friedenau, Bennigsenstrasse 25, Berlin, Germany. Lectures and reports should be sent to the Office of the Congress by February 1, 1939.

The Secretary, Central Board of Irrigation, writes :—Waterlogging and Land Reclamation are two of the subjects which have been under consideration by the Board since its institution in 1930 and as there are many problems connected therewith, which still remain unsolved, they will probably continue to be discussed annually by the Board and its research committee. In order to ascertain the present state of knowledge, to compare conditions in various parts of India and to decide what further investigations are necessary and the lines on which they should be undertaken, the Board prepared two questionnaires entitled "Questionnaire on conditions predisposing to harmful soil saturation which may ultimately result in waterlogging" and "Questionnaire on Land Reclamation". These were prepared with the assistance of Dr. E. Mackenzie-Taylor, M.B.E., Director, Punjab Irrigation Research Institute, and his staff and the replies to the questions which they provided, together with those supplied by Officers in other Provinces, were discussed by the Board and its Research Committee at their annual meetings in 1936 and 1937.

At its last annual meeting the Board decided that the questions and final replies accepted by the Board should be printed and published as "Notes on Waterlogging and Land Reclamation in the Form of a Questionnaire".

The Secretary of the Board will be glad to receive further information on any of the problems dealt with in this publication or to provide further detailed information if required.

According to a press communique issued by the **King George Thanksgiving (Anti-Tuberculosis) Fund,** a medical Post-graduate course will be held at the All-India Institute of Hygiene and Public Health, Calcutta, from January 30 to February 25, 1939. No admission or tuition fee will be charged. The course is open to registered medical practitioners whether in Government service or otherwise. There are 30 vacancies for the course. Selected candidates will be paid single II class railway fare, to and from Calcutta, up to a maximum of Rs. 100 per head. Applications in the prescribed form should reach the Secretary before December 10, 1938.

* * *

We acknowledge with thanks the receipt of the following:—

"Agricultural Gazette of New South Wales," Vol. 49, No. 10.

"Journal of Agricultural Research," Vol. 57, Nos. 4–6.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 29, No. 9.

"Agriculture and Live-stock in India," Vol. 8, No. 5.

"The Philippine Agriculturist," Vol. 27, No. 5.

"Journal of the Royal Society of Arts," Vol. 86, Nos. 4479–82.

"Biochemical Journal," Vol. 32, No. 9.

"Biological Reviews," Vol. 13, No. 4.

"Chemical Age," Vol. 39, Nos. 1004–1008.

"Journal of Chemical Physics," Vol. 6, No. 10.

"Berichte der deutschen chemischen Gesellschaft," Vol. 71, No. 10.

"Journal de Chemie Physique," Vol. 34, Nos. 8–9.

"Experiment Station Record," Vol. 79, Nos. 3–4.

"Transactions of the Faraday Society," Vol. 34, No. 210.

"Indian Forester," Vol. 54, No. 11.

"Forschungen und fortschritte," Vol. 14, No. 29.

"Medico-Surgical Suggestions," Vol. 7, No. 10.

"Calcutta Medical Journal," Vol. 34, No. 5.

"Review of Applied Mycology," Vol. 17, Nos. 9–10.

"American Museum of Natural History," Vol. 42, No. 3.

"Nature," Vol. 142, Nos. 3595–99.

"Journal of Nutrition," Vol. 16, No. 4.

"Proceedings of the Royal Society of Edinburgh," Vol. 53, Part 2.

"Research and Progress," Vol. 4, No. 6.

"Canadian Journal of Research," Vol. 16, Nos. 8–9.

"Science Progress," Vol. 33, No. 130.

"Indian Trade Journal," Vol. 131, Nos. 1686–89.

"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 8, Part 3.

Catalogues.

"Outfits for Absorption Spectrometry and Spectrographic Outfits." (Adam Hilger Ltd., London, July 1938).

"New Scientific and Technical Books," (Chapman & Hall Ltd., London). Autumn 1938.

"Monthly List of Books" (Weldon and Wesley), September, 1938.

"Diffusion Pumps for the Production of High Vacua" (W. Edward and Co., London).

ACADEMIES AND SOCIETIES.

National Academy of Sciences, India :

August 1938.—JAGRAJ BEHARI LAL : *Chemical Examination of the Fruits of* Physalis peruviana *or Cape Gooseberry, Part III.* J. DAYAL : *A New Trematode,* Gorgotrema barbius *N. Gen., N. Sp., from a Fresh-Water Fish,* Barbus sarana. M. A. H. SIDDIQUI AND R. V. SINGH : *The Fate of the Duct of Cuvier in Man and Certain Other Mammals.* P. SAMUELS LALL : *Certain Modifications of Dedekind's Theorem of Continuity.* R. D. VIDYARTHI : *New Avian Trematodes (Family Diplostomidæ) from Indian Birds.* A. C. BANERJI AND P. L. BHATNAGAR : *The Solution of Certain Types of Differential Equations.*

October 29.—B. P. PANDE : *On Two New Trematodes from Indian Cyprinoid Fishes with Remarks on the Genus* Allocreadium *looss.* B. P. PANDE *A New Strigeid Trematode of the genus* Crassiphiala *V. Haitsma,* 1925 (*Family* : Diplostomidæ Poirier) *from an Indian King-Fisher.* SUKHDEO BIHARI MATHUR : *A Note on the Telescope Method for Determining the Focal-length of Lenses and Mirrors.* K. B. MATHUR AND G. R. TOSHNIWAL : *F_2-Region Ionization in June* 1938 *at Allahabad.* JAGAT NARAIN TAYAL AND S. B. DUTT : *Chemical Examination of the Essential Oil of* Ocimum canum *sims.*

Indian Academy of Sciences:

October 1938. SECTION A.—KUNWAR MAHENDRA PRATAP SINGH AND SIKHIBHUSHAN DUTT : *Dyes derived from Chrysoquinone.*—A number of dyes closely analogous to those derived from phenanthrene have been prepared and their properties studied. R. D. DESAI AND M. EKHLAS : *Studies in the Friedel-Crafts Reaction. Part IV.—The Action of Acetyl Chloride and Acetic Anhydride on Resorcinol and its Derivatives. An Evidence for γ-Substitution in the Resorcinol Nucleus.* VON ALFRED MOESSNER AND A. GLODEN: *Diophantische Probleme.* (THE LATE) N. W. HIRWE, K. N. RANA AND (MISS) K. D. GAVANKAR : *Derivatives of Salicylic Acid. Part XIII.—Chloro-salicylic Acids and Their Methyl Esters.*—Convenient methods have been worked out for the preparation of 3-chlorosalicylic acid, 5-chlorosalicylic acid, 3-5-dichloro-salicylic acid, and their methyl ethers. S. RANGASWAMI AND T. R. SESHADRI : *Nuclear Methylation of Resacetophenone. Preparation of 3-Methylresacetophenone and Its Derivatives.*—With methyl iodide and methyl alcoholic potash, resacetophenone undergoes nuclear methylation in the 3-position and that the hydroxyl group in the fourth position gets esterified. S. RANGASWAMI : *A Fine Adjustment Device for Use with the Micro-Dumas Apparatus.* INDER CHOWLA : *Generalisation of a Theorem of Dickson.* V. R. THIRUVENKATACHAR : *Note on Harmonic Functions.* S. CHOWLA : *A Remark on g (n).* S. MINAKSHI SUNDARAM : *On an Infinite System of Non-linear Integral Equations.*

October 1938. SECTION B.—A. RAMAKRISHNA REDDY : *The Development of Anuran Kidney. Part I. The Development of the Mesonephros of* Rhacophorus maculatus, *Boulenger.* N. L. SHARMA : *Felspars from the Pegmatites of Kodarma, Bihar.* RAMDAS MENON : *Two New Species of Pachytroctidæ (Copeognatha) with a Note on the Family.* M. KRISHNA MENON : *The Early Larval Stages of Two Species of* Palæmon. S. M. DAS : *On* Ecteinascidia bombayensis *N.Sp. (A New Ascidian from Bombay).* B. N. SINGH, K. N. LAL AND K. PRASAD : *Photosynthetic Specificity in Relation to Biochemic Constitution of Leaves.* G. N. RANGASWAMI AYYANGAR AND K. KUNHI KRISHNAN NAMBIAR : *A 'Tiny' Sorghum.* G. N. RANGASWAMI AYYANGAR, V. PANDURANGA RAO AND T. VENKATARAMANA REDDY : *The Occurrence and Inheritance of Purple Anthers in Sorghum.* B. N. Singh AND S. PRASAD : *The Effect of Chlorine in Relation to Age upon the Growth and Composition of Wheat.* M. S. RANDHAWA : *Observations on Some Zygnemales from Northern India.—Part II.* V. RANGANATHAN AND B. N. SASTRI : *Digestibilities of the Proteins of Bengal Gram,* Cicer arietinum *Linn.*

Society of Biological Chemists, India:

BOMBAY. 30*th August* 1938.—A. FERNANDEZ : *The Excretion of Vitamin C in Urine and the State of Saturation in Normal Individuals in Bombay.*

INDORE. 10*th September* 1938.—K. A. PATWARDHAN : *The Disposal and Utilisation of Horse Dung and Stable Litter by Composting* ; 22*nd September* 1938.—S. S. DESHPANDE : *Essential Oil from Flowers of Mendhi and Laboratory Synthesis of Products occurring in Plants.*

CAWNPORE. 10*th September* 1938.—A. N. RAO : *Membrane Permeability.*

BANGALORE. 14*th September* 1938.—A. K. YEGNANARAYANA IYER : *Cloves* ; 30*th October* 1938.—V. RANGANATHAN : *The Availablity of Calcium and Phosphorus in a Few Typical Indian Diets.* K. GANAPATHI : *The Chemotherapy of Bacterial Infection.* A. L. SUNDARA RAO : *Nitrogen Fixation at Laboratory Temperatures and its Probable Significance in Agriculture.* V. RANGANATHAN AND Y. V. S. RAU : *Effect of Calcium on the Biological Value of the Proteins of Indian Diets.*

Errata.

Vol. VII, No. 5, November 1938, Page 231—

Column 1, 2nd line from the bottom of 1st para : *for* "nitrate" *read* "nitrite".

Column 2, 2nd para, line 2 : *for* "potassium nitrite" *read* "potassium nitrate".

1732-38—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore.

This Number Completes Volume VII

CURRENT SCIENCE

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Protection for Indian Sericulture.

THE Tariff Board have now completed their enquiry into the present condition of the Indian Sericultural Industry, and their report is awaited with anxious interest by all who have realised the importance of the industry to India.

The production of raw silk in India is confined at present to Mysore, Bengal, Madras and Kashmir. The industry is also practised in a few villages in Assam and the Punjab. The total silk production today is approximately:

		Lbs.
Mysore	..	800,000
Bengal	..	500,000
Madras	..	115,000
Kashmir	..	250,000

To the above may be added about 4,000 lbs. produced in Assam and the Punjab.

The total consumption of silk in India at the present time may be taken at about 42 lakhs of pounds, including about 25½ lakhs of pounds of imported foreign silk.

Conditions in India are favourable for silk production; and if adequately protected from aggressive foreign competition during the period of re-organisation, the Indian production of silk can be developed to meet the entire Indian demand. The Tariff Board in 1933 reported:

"We are satisfied that the climate of great portions of India affords facilities for the cultivation of mulberry, and for the rearing of silk-worms" (p. 136).

"We are equally satisfied that the industry cannot exist without protection, much less develop rapidly" (p. 140).

It is not easy to put the case for protection better or more convincingly than has been done in Chapter XII of the Report of the Tariff Board of 1933, which may be regarded as a classic on the subject. It proves conclusively that the Indian Silk Industry satisfies the Fiscal Commission's requirement to qualify for protection, that the industry should not only have an important place in the country's economic life, but should be one for which the country has special advantages; that its present position should be such that it cannot exist without protection against foreign competition; and that if protected adequately during the period of development, it should be capable of maintaining itself in future without protection.

Though their findings on essential facts were correct, the Tariff Board's recommendations were unfortunately timid and inadequate. At a time when intense foreign competition was causing a rapid and continuous fall in prices, they recommended the levy of a specific duty of Rs. 2–6–0 per pound on imported silk, or in the alternative, a duty of 50% *ad valorem* whichever was higher. Even as the Government of India were considering this recommendation, it had already become inadequate; yet, the Government of India, while recognising the title of Sericulture to protection sanctioned a measure which fell much short even of this proposal. They sanctioned a duty of 25% *ad valorem, plus* a specific duty of Re. 0–14–0 per pound of silk, which on the prices then prevailing, worked out to a total of about Rs. 1–10–0 per pound. As the ex-duty price of foreign silk had by then dropped to Rs. 3–11–5, that silk could be bought in Indian markets at Rs. 5–6–0 while according to the Tariff Board's own finding Indian *Charaka* silk of competing quality could not be offered at less than Rs. 6–2–6, and Indian Filature silk at less than Rs. 6–10–9 per pound. The result, as may be expected, was that the duty has been found too low to be effective as protection, and that Indian Sericulture exposed as it is to the full blast of foreign competition, has not been able to organise itself. The attack is now from the State-aided sericulture of Japan, and is ruthless in character. Though Indian Sericulture has been putting up a gallant fight for its existence—it has been steadily losing ground, and is in greater danger to-day than it was five years ago.

The present Tariff Board has been appointed to review the situation and to submit fresh proposals in the light of five years' experience. From the very complete questionnaire issued by them, it is evident that they wish to ascertain whether, and if so to what extent, the Indian Sericultural Industry has responded to the "protection" extended to it during this period, and whether the Governments concerned have taken adequate action in the discharge of their correlative duty to stimulate and organise it under the shelter of this protection.

There can be no possible doubt that the silk industry of India has suffered a serious set-back during the past five years. We have not to hand figures relating to other states and provinces, but the shrinkage of the mulberry area in Mysore, which produces about half the total Indian output, may perhaps afford an indication of the extent of this loss:

		Acres
1933–34	..	32,869
1934–35	..	30,228
1935–36	..	28,528
1936–37	..	25,131
1937–38	..	26,500

This contraction has taken place in spite of the Mysore Government's utmost efforts, and the stout-hearted optimism of the Mysore peasant, simply because the so-called protective duty gives no protection at all.

For real protection, the duty should at least bridge the gap between the cost of production of the article at home, and the price at which the competing foreign product is offered for sale, at any rate in home markets. Whether the duty in any case *does* bridge the gap is a point of fact, not of degree, and certainly not of opinion. A partial bridge may be evidence of good intention, but is not protection. It is like leaping a chasm, just a trifle short. Inadequate protection is appreciably worse than no protection at all, for it lures men to their loss by creating an illusion of safety. In the present case, in spite of the so-called protection granted by the Government of India—and partly no doubt even because of it—the area under mulberry in Mysore has steadily dropped from 32,869 acres in 1933–34 to 26,000 acres in 1937–38. This drop has not been due to any competing crop or occupation, but directly to failure in fact to protect.

When it is admitted, as it is by the Tariff Board of 1933 in their report, and by the Government of India in accepting it, that the silk industry is one which can and ought to be protected, the only issue now before the Tariff Board and the Government of India becomes narrowed to this :—

What should the duty be to operate as a real protection?

The answer depends essentially on the cost of production of the grade of Indian silk which can compete with foreign imports. The quality should be as good as that of competing foreign silk. This means, that we have to take the cost of production of Indian silk in Filatures of modern type. The cost of production in the crude *Charaka* now generally in use, is of course lower, but *Charaka* silk is defective, and has no future,

Owing to the changed character of the Indian demand as a result of the impact of foreign imports, *Charaka* silk has definitely lost favour, and is maintaining a precarious foothold by a ruinous sacrifice in prices. It has no chance of survival. Therefore, the problem is not now one of protecting *Charaka* silk. Charakas are bound to go; and if Filatures do not take their place, Sericulture will go with them. Filatures are essential to the stability of Indian Sericulture as they alone can make an effective demand for cocoons, and as they alone can meet the competition of foreign silk and satisfy the requirements of the Indian weaver.

We shall now state what we mean by an effective demand for cocoons. For cocoons, as for other goods, there is a return, below which the producer will not consent to produce. The last Tariff Board, after going carefully into this question, found Re. 0–5–0 a pound a reasonable price. This estimate was by no means too generous, for the barest cost of production in Mysore and Kollegal is about Re. 0–4–5 per pound, not taking into account remuneration for the work of the family. The production of cocoons by an average family may be taken at about 550 lbs. a year, which, if the cocoons realised Re. 0–5–0 a pound, would add about Rs. 20 a year to the family budget—not a very attractive return for a year's almost continuous work, but one which, in the peculiar circumstances of the case, has been found just enough to prevent the family from giving up the industry. That Re. 0–5–0 per pound is the minimum price at which cocoons will continue to be produced, receives convincing corroboration from the statistical figures.

In spite of the "Protection" granted in 1934 the price of cocoons remained as a rule below Re. 0–4–0 per pound till the end of 1936, and during this period the acreage under mulberry fell from 32,869 to about 26,000. In 1937, the prices went up, and fluttered at a level above five annas. During this brief and fitful prosperity, an additional area of about 2,500 acres was planted with mulberry. About the middle of 1937, the prices showed a downward tendency and in October of that year dropped sharply below the 5 annas level. They have moved down grade, and are yet round about $4\frac{1}{3}$ annas. This sharp decline resulted almost immediately in the neglect and even abandonment of the new plantations.

This indicates:

(1) When the price of cocoons rises above five annas per pound, there is a tendency towards expansion of the mulberry area.

(2) When it falls below that level, there is a tendency towards contraction.

It is needless to say that the area under mulberry is a sure index of Sericulture.

A price of five annas per pound is therefore the minimum below which the average rearer will have no inducement to produce cocoons. We have also explained why Filatures are essential to the industry. The irresistible conclusion is that there can be no effectful protection of the industry, unless Filatures are placed in a position to pay Re. 0–5–0 per pound for cocoons. In other words, the pitch of the protective duty should be adequate to raise the price of Filature silk to a level such as would enable Indian filatures to pay five annas a pound for their cocoons and to make a reasonable manufacturing profit. According to careful estimates, the cost of production of a pound of Filature silk in India works out to Rs. 7–0–0. Adding to this $6\frac{1}{4}\%$ for incidental and selling costs, we reach a fair selling price of Rs. 7–7–0 per pound.

To arrive at the protection necessary, we have to ascertain the ex-duty price of imported silk. The safest way of doing this would be to take the actual price of foreign silk in Indian markets, and work back by deducting the duty and other charges. A fixed Tariff valuation like that now in vogue is obviously inappropriate. Nor would it be safe to rely on invoices alone, unchecked by comparison with selling prices in the markets of India obtained from the Chambers of Commerce, Silk Associations, Departments of Industries and Commerce and other reliable sources.

We are convinced that the Indian Silk Industry is in greater danger to-day than it was in 1933, because it has to live against a far deadlier competition.

We are of opinion that the following measures are necessary:

(1) The import duty should be raised sufficiently to prevent foreign silk from selling in India at prices lower than the cost of production of Indian Filature silk.

The average selling price of Japanese silk to-day is Rs. 6–4–0, which would give an ex-duty price of Rs. 4–4–9. A sufficient duty on this basis would be Rs. 7–7–0 *minus* Rs. 4–4–9 or Rs. 3–2–3. Since we do not

know the trend of prices of foreign silk, it may be better to adopt a formula than to fix a specific duty. The formula may take some such form as this :

Rs. 7–7–0 *minus* ex-duty price of foreign silk *plus* (or *minus*) correction to exchange. An alternative would be a specific duty providing a margin to cover fluctuations. In this case perhaps Rs. 3–12–0 may not be excessive.

(2) The same rate of duty should be levied on silk yarn, thrown silk, spun silk and wrought silk of all descriptions.

(3) The duty on silk piece-goods should be correspondingly raised.

(4) Protection should be granted for a period of not less than ten years, to give the industry sufficient time to re-organise itself. A shorter period would not suffice as some of the measures to be taken, such as the substitution of tree for bush in mulberry cultivation, would require time to yield results, and the organisation of the industry has to be wrought out with a rural and conservative population.

(5) Indian silk should get imperial preference as it is a resource of the first importance in peace and in war.

The Japanese competition is now taking a form which bids fair to throttle the Silk Throwing Industry ; and obviously the next industry to be attacked will be hand-loom weaving. Protection to Sericulture proper is essentially protection to silk throwing and hand-loom weaving. The fact that there are about 60,000 hand-looms producing annually about 10 crores of rupees worth of goods, raises protection for silk into a measure of all-India importance.

N. Rama Rao.

International Congress of Physiologists, Zurich, 1938.

The XVIth International Congress of Physiologists in Zurich, August 14–19, 1938, marked the 50th anniversary of the first Congress which was also held in Switzerland. Every effort was made to provide the physical equipment and surroundings necessary for the fulfilment of the purposes of the meeting and in this the Committees were uniformly successful. The space made available in the splendid buildings of the Technische Hochschule and the Universität served admirably as a setting for the scientific sessions and the discussions ; formal and informal, which are so vital a part of an international congress. Approximately 1,400 persons were registered and four-fifths of these were present. The lectures, demonstrations, and film presentations were well attended by enthusiastic groups.

At the opening session, tribute was paid to the surviving participants of the first Congress. Throughout the rest of the week eight morning or afternoon scientific sessions were held in five sections simultaneously. Of these it will only be possible to mention fields of physiology which were represented. Certain sessions, which attracted great interest, were given over to general discussions of chosen topics, beginning with special introductory addresses. These general discussions included those on the following subjects ;

Function of the parts of the renal excretory system, intermediary metabolism (role of dibasic acids, yellow ferment, free radicals), sterols, hormones, anterior hypophyseal hormones, cholinergy and adrenergy, respiratory reflexes, respiration in fetal life, function of the adrenal cortex, cell parameters, connection of local metabolism with circulatory regulation, pharmacology and the permeability of the skin to pharmaceuticals, potential poisons, nutrition, electro-acoustic analysis of speech.

Furthermore, in the regular sessions, certain subjects which received a considerable amount of attention were : heat regulation, the role of iron and protein in anemias, circulation and the circulatory system, fat chemistry and metabolism, metabolism of carbohydrates and ascorbic and pyruvic acids, muscle and nerve physiology, glandular secretion, protein chemistry and metabolism.

A business meeting at which it was voted to hold the next International Congress in England, concluded the formal programme of the week. It is safe to say that each of the participants returned home with a renewed appreciation of the part the International Congresses play in furthering the united advance in the intensely interesting and complex field of the physiological sciences.

Rollin D. Hotchkiss.

Schwann's Cell-Theory.

The Basis of One Hundred Years Investigation of Vital Processes.

By Everett White Melson.
(*Bausch & Lomb Optical Co., Rochester, New York.*)

THE cell-theory, which Theodore Schwann gave us one hundred years ago, has been followed by such a wealth of confirmation that we are justified to-day in rating it as the most fundamental concept in the whole science of modern biology. Botanist, zoologist, physiologist and pathologist study the cell in their search for the vital phenomena which take place there during health and disease.

The cell-theory has brought us, over the course of time, to some tremendous implications, involving the mechanism, the chemistry and the physiology of reproduction; further studies on the origin and evolution of species, and on those forces—both internal and external—which affect the rise and fall of racial stocks. Since evolution is essentially a change in the hereditary endowment of succeeding generations, the units of heredity are the only ones that are likely to prove useful as units of evolution.

Dobzhansky says :—

"By far the greatest achievement of genetics to date is the establishment of the fact that the hereditary materials transmitted from parents to offspring are composed of discrete particles known as genes," "Genes have their physical abode in the microscopical cellular elements known as chromosomes."

The great scope of present investigations on the cell may be traced to the work of Schleiden and Schwann, whose names have been euphoniously associated, since 1839, with the development of the cell-theory. Schwann overshadows all others, practically to exclusion, when the history of the cell concept is under consideration. Since he was a great man, however, it is not surprising to find that he acknowledges a debt to a number of men in many fields. His contribution was one of synthesis; of weaving the mass of indigestible material into a stimulating generalization.

Various candidates appear to have had just claims to having first seen the cell. To Robert Hooke, mathematician, astronomer, physicist, chemist and physiologist, is credited the first published account of the cell. This appeared in his *Micrographia* in 1665, a volume which ranged over the entire field of natural objects animate and inanimate and which, incidentally, contains the first illustration of a compound microscope, although it was invented eighty years before Hooke's observations. He might have advanced the cell concept materially if his roving genius had not shifted so continuously. Swammerdam, a Dutch investigator, saw the blood corpuscles of the frog in 1653, but his work was not published until 1738, long after his death. His description lacked the clarity of Hooke's work.

In 1661, Malpighi wrote Borelli two letters describing the air sacs in the lungs with their capillaries, and in 1670 his *Anatomy of Plants* was published containing a description of cells more accurate and significant than Hooke's. He found, according to Huxley, that the walls of the cells could be separated and he regarded them as independent entities, although they were units which coalesced to make up the plant as a whole. He called them "utriculi" or "sacculi", mentioning them repeatedly in his descriptions of the different parts of plants and illustrating them in pictures. Malpighi was the first real histologist, both of plants and animals, corpuscles of the kidney and spleen being named after him to-day, but it is evident he regarded cells as of small importance.

Van Leeuwenhoek gave the first accurate and extensive description of the blood corpuscles in 1674, using them frequently in his work as a standard of size for minute observations. He also described the sperm, resolved some of the tissues into cellular units, and recognised the cross-striated fibrillæ of muscle. In 1759, Wolff gave proof that he saw the cells of both plants and animals, pointing to the correspondence between them. Huxley refers to Wolff's Theoria Generationis as follows :

"Wolff's doctrine concerning histological development is shortly this. Every organ is composed at first of a little mass of clear, viscous, nutritive fluid, which possesses no organization of any kind, but is at most composed of globules. In this semi-fluid mass, cavities are now developed, these, if they remain rounded or polygonal, become the subsequent cells—if they

elongate the vessels; and the process is identically the same, whether it is examined in the vegetating point of a plant, or in the young budding organs of an animal. Both cells and vessels may subsequently be thickened by deposits from the nutritive fluid. In each case they are mere cavities, and not independent entities; organization is not effective by them, but they are the visible results of the action of the organizing power inherent in the living mass, or what Wolff calls the 'vis essentials'."

A mass of data continued to accumulate from various men. Among these may be mentioned Treviranus, Heusinger, Prevost, Milne-Edwards, Hodgkin, Baumgartner, Arnold and Valentin. They undoubtedly saw cells and probably the nuclei of cells but the significance escaped them.

But to Rene-Joachim-Henri Dutrochet, who obtained his medical degree in 1806, at the age of twenty-nine, goes the credit for a statement of such clarity concerning the cell that he cannot be passed over in any history of the theory. Retiring from practice, broken in health, following his service as an army surgeon with Joseph Bonaparte, in Spain, he devoted himself to science, most of his papers being sent to the Paris Academy of Sciences. Although his greatest contributions were in the field of plant physiology, he made important contributions to embryology and histology.

His microscopic studies for the years 1822 and 1823 were assembled into a monograph and published in 1824 under the title: "*Recherches anatomique et physiologique sur la structure intime des animaux et des vegetaux, et sur leur motilite.*"

From Rich's translation we learn the following:

"I must repeat here that which I have stated above regarding the organic texture of plants: we have seen that plants are composed entirely of cells, or of organs which are obviously derived from cells; we have seen that these cells are merely contiguous and adherent to each other by cohesion, but that they do not form a tissue exactly continuous. The organic being has appeared to us, therefore, to be composed of an infinite number of microscopic parts, which are related only in proximity. Now the observations on animals which we have just described obviously confirm this view.

"In the organs of vertebrates, the globular corpuscles are so small that it is impossible to know whether they are solid or vesicular bodies; but in molluscs that is very easy to determine. When one examines microscopically the tissue of the liver, the testis or the salivary glands of Helix or Limax, one sees that these secretory organs are composed, like those of vertebrates, of little globular bodies assembled in a confused manner; but here these little bodies are not so excessively small. They are indeed quite large (for microscopic objects) and one can see in the clearest manner that they are vesicular bodies or true cells, the walls of which contain other very minute corpuscles."

Dutrochet says further:

"One can therefore draw the general conclusion that the globular corpuscles which make up all the organic tissues of animals are really globular cells of an extreme smallness, which are united only by cohesion. Thus all the tissues, all the organs of animals are really only cellular tissue diversely modified. This uniformity of ultimate structure proves that organs really differ from one another only in the nature of the substances which are contained in the vesicular cells of which they are composed. All of the organic tissues of plants are made of cells and observation has now demonstrated to us that the same is true of animals."

Dutrochet has established the anatomical identity of the cell and went on to its physiology in another passage:

"It is within the cell that the secretion of the fluid peculiar to each organ is effected. These fluids are probably transmitted by transudation into the excretory canals. Thus the cell is the secreting organ *par excellence.* It secretes, inside itself, substances which are, in some cases, destined to be transported to the outside of the body by way of the excretory ducts, and in others, destined to remain within the cell which has produced them, thus playing specific roles in the vital economy.

"In each organ the cells must have different characteristics, since such different substances are secreted within them. In this connection one cannot help admiring the prodigious diversity of the products of living beings—a diversity which is even greater in the plant kingdom than in the animal kingdom.

"What a variety in the physical and chemical qualities of the living body are organic solids? The membrane and the shell of the bird's egg are not formed by a real growth as true organic solids are: they are formed rather by the coagulation or hardening of certain secreted fluids. Microscopic examination reveals no organic texture in such solids formed by the hardening of secreted fluids. On the other hand, whenever one finds an organic texture in the body, one can say without hesitation that that part was once alive, and that it has consequently been formed by true growth. Now an organic texture can be clearly recognised in all parts of feathers. The spongy substance is made up of a mass of globular utricles. It is true cellular or utricular tissue resembling the cellular tissue which is seen in certain parts of plants; it is, in a way, an animal cork."

While the phenomenon of osmosis had been observed in isolated instances, it was neither understood nor applied in any way. Dutrochet made the discovery independently and applied it in fathoming the mechanism of cellular activity. Not content with his numerous observations, clearly

set down, he was eager to apply them to physiology as noted in this statement:

"The physiological connections which I have established between plants and animals make it clear that there is but a single physiology; a general science dealing with the functions of living beings—functions which vary in their mode of execution but which are fundamentally identical in all organized beings. I hope that some day, out of these first attempts, there will be born a new science—*general physiology.*"

Certainly, as Goss says, the experiments of Detrochet made the recognition of the cell as a structural, functional, and developmental unit a necessity. Only the nucleus is left out.

It is not known whether Schwann heard Dutrochet's papers at the Paris Academy, but both men presented material through the Academy. And Schleiden, in his *Phytogenesis,* refers to Dutrochet in a foot-note.

Schleiden's claim to glory is generally considered to rest on his recognition of the fact that increase in the size and number of cells is responsible for growth. Said he,

"Growth results both from the increase in the volume of cells, and from the addition of new little cells,"

and after citing his evidence he says,

"It is evident, therefore, that during growth, new rudimentary cells are formed which, by increasing in size, finally become cells such as those which have preceded them in order of appearance and development."

Schleiden's paper on Phytogenesis, published in the same volume as Schwann's work, by the Sydenham Society, is given with such circumlocution that it is scarcely recognizable in the clearly stated abstract of it found in Schwann's work.

In the opinion of Goss, the following statement of Schleiden should divorce him completely from all connection with the cell-theory:

"The plant unfolds itself by the expansion and development of the cells already formed. It is this phenomenon especially, one altogether peculiar to plants, which, because it depends upon the fact of their being composed of cells, can never occur in any, not even the most remote form in crystals or animals."

It is difficult to comprehend how Schwann obtained the inspiration he attributes to Schleiden, unless it was a desire to disprove the categorical statement that animals could not by the remotest possibility be made up of cells. Indeed, Schwann says,

"The principal object of our investigations was to prove the accordance of the elementary parts of animals with the cells of plants."

As if the proof of likeness between plants and animals were insufficient, Schwann finished his treatise with refutation of Schleiden's statement concerning crystals using these words:

"The material of which the cells are composed is capable of producing chemical changes in the substance with which it is in contact, just as the well-known preparation of platinum converts alcohol into acetic acid. This power is possessed by every part of the cell. Now, if the cytoblastema be so changed by a cell already formed, that a substance is produced which cannot be attached to the cell, it immediately crystallizes as the central nucleolus of a new cell. And then this converts the cytoblastema in the same manner. A portion of that which is converted may remain in the cytoblastema of new cells; another portion, the cell-substance, crystallises around the central corpuscle.

"The cell-substance is either soluble in the cytoblastema, and crystallizes from it, as soon as the latter becomes saturated with it, or else it is insoluble, and crystallizes at the time of its formation, according to the laws of crystallization of bodies capable of inhibition mentioned above, forming in this manner one or more layers around the central corpuscle, and so on."

In all Schwann's work his exposition is clear. His power to make generalizations is demonstrated in this statement of his cell-theory:

"The elementary parts of all tissues are formed of cells in an analogous, though very diversified manner, so that it may be asserted, that there is one universal principle of development for the elementary parts of organisms, however, different, and that this principle is the formation of cells. This is the chief result of observations.

"The same process of development and transformation of cells within a structureless substance is repeated in the formation of all the organs of an organism, as well as in the formation of new organisms; and the fundamental phenomenon attending the exertion of productive power in organic nature is accordingly as follows: a structureless substance is present in the first instance, which lies either around or in the interior of cells already existing, and cells are formed in it in accordance with certain laws, which cells become developed in various ways into the elmentary parts of organisms.

"The development of the proposition, that there exists one general principle for the formation of all organic productions, and that this principle is the formation of cells, as well as the conclusions which may be drawn from this proposition, may be comprised under the term *cell-theory*, using it in its more extended signification, whilst in a more limited sense, by theory of the cells we understand whatever may be inferred from this proposition with respect to the powers from which these phenomena result."

During the year 1838, Schwann, in the course of conversation with Schleiden was

informed of the latter's theories of cell-formation in plants. It struck Schwann that there were many points of resemblance between animal and vegetable cells. Two circumstances contributed to the rapid and brilliant result of Schwann's subsequent observations. He made the greatest use of the nucleus in demonstrating the animal cell while emphasizing that it was the most characteristic and least variable of its constituents. Schwann, following the work of the botanists, devoted special attention to the development of animal tissues, discovering that the embryo, at its earliest stage, consisted of a number of quite similar cells. He then traced the metamorphoses or transformations which the cells underwent, until they developed into fully formed tissues of the adult animal.

He showed that while a portion of the cells retain their original spherical shape, others become cylindrical in form, and yet others develop into long threads, or star-shaped bodies, which send out numerous radiating processes from various parts of their surface. He observed that bones, cartilage, teeth, and various tissues become surrounded by firm cell walls of varying thicknesses, and finally, he explained the appearance of a number of the most typical tissues by showing that groups of cells become fused together, analogous to the development of the cell structure in plants. Schwann also studied metabolism and gave it its Greek derivation.

His materialistic view of living matter made him a scientific missionary of the first rank; his errors in observation and his conclusions in regard to the nucleus make his work seem incomplete as compared with modern cytology, but it must be remembered that he knew nothing of mitotic division and the whole science of genetics with its cytological implications was in the distant future.

Schwann led off in the great attack in which the Protoplasmic Theory was later worked out by Mohl, Cohn, Kolliker, Bischoff, Max Schultze and the physiologist, Brucke.

Hertwig-Campbell, *The Cell.*

Trend in Modern Genetics, Laughlin.

Historical Background of Schwann's Cell Theory, C. M. Goss.

Raw Materials of Evolution, Theodosius Dobzhansky.

The Cell Doctrine, J. Tyson.

The Cell Theory, Thos. H. Huxley.

The Size and Number of the Chloroplasts and the Chlorophyll Content in Eupolyploid Forms Experimentally Produced.

By Dontcho Kostoff.

(Institute of Genetics, Academy of Sciences, Moscow.)

In my previous publications[1, 2, 3, 4, 5] I have shown that eupolyploidy in plants conditions a series of hereditable changes. Some are "directed," others are not. Directed, hereditable variations in plants which show an increase with the euploid increase of the chromosomes are: (1) the amount of the nucleolar substances (number of nucleolei, size, or both), (2) the size of the nuclei, (3) the amount of cytoplasm, (4) the volume of the cells, (5) the breadth of the leaves, (6) the thickness of the leaves, (7) the size of the ovules, (8) the size of the seeds or of the grains, (9) the dark green colour of the leaves, (10) the size of the anthers, (11) the breadth of stigmas and styles and (12) the length of all kinds of trichomes. With the euploid increase of the chromosomes the vegetation period (the period between sowing and flowering) is usually prolonged. Characters like the size of the plants and the size of the flowers are also influenced by the euploid chromosome alterations, but there is no correlation between euploid chromosome alteration and the expression of these characters. In some cases the size of the plant increases with the euploid increase of the chromosomes, in other cases it decreases. The length of the flowers (corolla, calyx) vary in a similar way. The whole habitus of the tetraploids is coarser than that of the diploids,

1 Kostoff, D., *Chronica Botanica*, 1938, 4.

2 —, *Journal of Genetics*, 1938 (in the press).

3 —, *Curr. Sci.*, 1938 1938, 7, 108.

4 —, and Kendall, J. *Gartenbauwissenschaften*, 1934, **Bd. 9**, 22–44.

5 —, and Orlov, A. *Ann. Bot.*, *N.S.*, 1938, **2**, N, 8.

The size of the chloroplasts seems to behave differently from the characters mentioned above. This is at least true for the higher plants, especially for *Nicotiana* and *Solanum* polyploids which I have studied.

Considering the existing discrepancies upon this question we studied with Orlov[5] the size of the chloroplasts in a large number of autotetraploid and allopolyploid plants in respect to their diploid ancestors. These studies showed that all polyploids did not have larger plastids, on the contrary in a few cases there was some tendency to decrease in the size of the chloroplasts in the experimentally produced polyploids.

More recently, in applying colchicine and acenaphthene,[6,7,8] I obtained about thirty tetraploid and octaploid plants from about fifteen species and hybrids. In addition to the above-mentioned statements it was necessary to investigate the size of the chloroplasts in the octaploids that were not included in the previous studies.

I took for these studies F_1 — *Nicotiana alata* — *Sanderæ* diploid ($2n = 18$), tetraploid ($4n = 36$) and octaploid ($8n = 72$) forms obtained by colchicine treatment.

Leaves of these plants were taken and kept for about 10 minutes in tap water (in a dish) for increasing their turgidity. Then the epidermis of the under-side of the leaves was torn by breaking the leaves. Epidermis "skins" were put on glass slides on a large drop of water. I added then a drop of 2% I + KI — solution and put the cover glass. The excess of liquid was pulled out by blotting paper. In such preparations the chloroplasts were distinctly stained, so that I could count them and measure them very easily. The measurements were made by Zeiss microscope, ocular 20 and objective oil immersion × 90, one ocular micrometer division being 1·1 microns. The data obtained are given in Table I. These data show that there is no significant difference between the size of the chloroplasts in the diploid, tetraploid and octaploid plants.

What might cause then the dark green colour of the leaves of the octaploids in comparison to that of the tetraploids and diploids, and in tetraploids in comparison to that of diploids? In order to answer this question the number of chloroplasts per cell and the amount of chlorophyll per unit leaf surface were determined.

I counted the number of the chloroplasts in the stomata board cells (in both together) of the $2n$, $4n$ and $8n$ plants in preparations obtained by the above described method. Epidermis was taken from completely developed leaves, but not too old. The data obtained are given in Table II. They show that $2n$ plants had on the average 17·18 chloroplasts per a couple of stomata cells, $4n$ had 36·46 and $8n$ had 61·70 chloroplasts. The number of chloroplasts per cell vary much more in the tetraploid and octaploid plants than in diploid plants, σ being 1·79, 4·80 and 6·94 and m being 0·25, 0·73, and 0·98 in $2n$, $4n$ and $8n$ respectively.

The leaves of the octaploids had larger cells and were thicker than those of the tetraploid plants as well as those of tetraploid plants in respect to the leaves of diploid plants. I cut out equal discs (2 cm. in diameter) from leaves of $2n$, $4n$ and $8n$ plants for studying the relative amount of chlorophyll in these discs. The discs of $8n$ plants were the heaviest, then came those of $4n$ plants and finally those of $2n$ plants. The same regularities were found when the fresh material was dried. Discs of F_1 *N. alata-Sanderæ* plants, for example, of $2n$, $4n$ and $8n$ (all having a diameter of 2 cm. when they were fresh) were dried at 60° C. and weighed. Discs of the diploids weighed 9·9 mgr., those of the tetraploids 16·8 mgr. and those of the octaploids—23·5 mgr.

For studying the relative content of the chlorophyll in this polyploid series I cut out leaf discs, 2 cm. diameter at a distance about 2 cm. from the apex from completely developed (though not too old) leaves of $2n$, $4n$ and $8n$ plants. Each disc was crushed in a mortar with 10 c.c. 96% alcohol in the following way: The disc was very well crushed in a mortar with a few drops of alcohol, then about the half of the 10 c.c. alcohol previously measured was added and then transferred for filtration through a filter-paper. The other part of the alcohol was used for washing the mortar and the pestle two times, adding each time the alcohol to the filter. The concentrations of the alcohol

6 Kostoff, D., *Compt. Rend. Acad. Sci.*, Moscow, 1938, **19**, 189–91.

7 —, *Curr. Sci.*, 1938, **6**, 549, 552.

8 —, *Ibid.*, 1938, **7**, 8–11.

TABLE I.

Diameter of the Chloroplasts in Diploid, Tetraploid and Octaploid Nicotiana alata Sanderæ *Plants.*

No.	Plant chromosomes	Ocular micrometer divisions						n	M	σ	m
		4	4·5	5	5·5	6	6·5				
1	$2n = 18$	5	9	25	18	12	4	73	5·24	0·62	0·07
2	$4n = 36$	6	8	23	27	10	3	77	5·23	0·59	0·07
3	$8n = 72$	9	15	24	15	9	0	72	5·00	0·59	0·07

$M_2 - M_1 \pm m$ diff. $= 0·01 \pm 0·10$ $M_3 - M_2 \pm m$ diff. $= 0·24 \pm 0·10$ $M_3 - M_1 \pm m$ diff. $= 0·23 \pm 0·10$

TABLE II.

The Number of Chloroplasts per couple of Stomata Board Cells from Diploid, Tetraploid and Octaploid F_1 Hybrids Nicotiana Sandaræ alata.

No.	Plant chromosome numbers	Number of chloroplasts per couple of stomata board cells																		n	M	σ	m
		14–16	17–19	20–22	28–30	31–33	34–36	37–39	40–42	43–45	46–48	49–51	52–54	55–57	58–60	61–63	64–64	67–69	70–72				
1	$2n = 18$	18	29	4																51	17·18	1·79	0·25
2	$4n = 36$				3	10	12	7	6	3	1	1								43	36·46	4·80	0·73
3	$8n = 72$									1	0	3	4	2	7	10	14	5	4	50	61·70	6·94	0·98

$M_2 - M_1 \pm m$ diff. $= 19·28 \pm 0·77$; $M_3 - M_2 \pm m$ diff. $= 25·24 \pm 1·22$, $M_3 - M_1 \pm m$ diff. $= 44·52 \pm 1·01$

extracts thus obtained were measured by Dubosq colorimeter. Guthrie[9] solution was used for standard. The measurements were carried out when the standard plunger was adjusted at 5·0. Three samples were studied. The results obtained are given in Table III.

TABLE III.

Plant	Measurement in divisions			M
Diploid ($2n$) ..	18·3	17·6	16·9	17·6
Tetraploid ($4n$) ..	13·9	14·8	14·2	14·3
Octaploid ($8n$) ..	10·2	11·8	10·9	10·9

Similar extracts were prepared from dried discs after crushing and extracting them for 24 hours in 10 c.c. 96 % alcohol. The data obtained from these extractions are given in Table IV. The plunger of the Guthrie's standard solution tube was adjusted at fifth division. Three samples were studied.

TABLE IV.

Plant	Measurements in divisions			M
Diploid ($2n$) ..	21·2	21·7	20·9	21·3
Tetraploid (n) ..	17·3	16·8	17·4	17·2
Octoploid ($8n$) ..	13·8	14·2	14·9	14·3

The data given in Tables III and IV show that chlorophyll extracts of octaploid plants were most concentrated, then came the extracts of the tetraploid form and at the end, the less concentrated ones of the diploid original form.

[9] Guthrie, J. D., *Amer. Journ. Bot.*, 1928, **15**, 86–87.

I can conclude on the basis of the above reported data that the dark green colour of the leaves of the euploid forms in comparison to their original ones is due to the larger amount of chlorophyll per leaf surface unit. Leaves of polyploid plants are thicker, the thickness being due to the larger dimensions of the leaf cells. Larger cells have larger number of chloroplasts. These factors condition the larger amount of chlorophyll in the polyploid plants. The size of the chloroplasts is not responsible for the larger amount of chlorophyll in the polyploids since the euploid chromosome alterations do not lead to an increase in size of the chloroplasts, the latter being highly autonomous in respect to eupolyploid chromosome alterations.

It seems logical to postulate that the polyploid forms, having larger amount of chlorophyll, should have a greater assimilation ability per surface unit and should produce a greater amount of carbohydrates per surface unit.

An Interpretation of the Benham Colour Phenomena in Terms of the Hysteresial Augmentation Theory of Professor Burridge.

By P. S. Naidu, *Annamalai University.*

THE chromatic responses elicited by simple black and white stimuli have been studied by Fechner, Helmholtz,[1] Nicholls,[2] Bidwell[3] and others. When a disc containing black and white sectors is revolved rapidly blue and yellow rings develop very quickly. This development of coloured rings is a remarkable phenomenon in itself. But the most striking development of colours occurs in connection with the manipulation of, what is popularly known as, the Benham's Top. The striking behaviour of this revolving disc has been studied by Bidwell,[4] V. Kries,[5] Pieron[6] and Parsons,[7] and partial explanations have been given by all of them, especially by Pieron and Parsons. V. Kries admits that 'these phenomena are as yet only partially understood, and cannot be classified or positively explained'. Pieron and Parsons attempt to explain the generation of colour sensations by simple black and white stimuli as due to induction by certain spatio-temporal patterns. The latter says, 'When light falls upon the retina the luminous sensation rises rapidly and falls gradually ....It is seen that the rapidity and amount of rise of sensation varies with the intensity of the stimulus, and also with the wave-lengths of monochromatic lights. The maximum is greatest with blue, least with green, and intermediate with red. It is probable that Fechner's colours seen with rotating black and white sectors, and the colours seen with Benham's Top are due to this cause.'[8]

Attempts have been made to explain the generation of colours by the well-known phenomena of contrast, successive and simultaneous. But all such explanations have been disapproved by Pieron and Parsons who show that the colours develop in monochromatic light.[9] We shall refer to this point again. Neither the 'contrast' explanation nor the 'spatio-temporal' explanation is satisfying; and so we are not surprised to find Parsons striking a disconsolate note when he concludes his discussions with the following remarks: 'Pieron's explanation of this fact is obscure and unsatisfactory. It is more probable that the true explanation depends upon reciprocal induction, but that theory also involves difficulties in time relations.'[10]

Our experiment with the Benham's Top yielded very interesting results. Instead of the usual cardboard disc, we used a circular glass disc, painted with Indian ink, as shown in Fig. 1. This was backed by a circular white board of the same diameter as the glass disc and mounted on a motor whose speed was regulated by the use of

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1 *Physiological Optics*, p. 215.

2 *American Journal of Science*, 1884, **28**, 243.

3 *Proc. Roy. Soc.*, 1896, **60**, 368.

4 *Curiosities of Light and Sight.*

5 Helmoltz, *Physiological Optics*, **2**. Approved by V. Kries.

6 *L' Annee Psychol.*, 1923, **23**.

7 *The Theory of Perception*, Ch. xi, pp. 89-101.

8 *Colour Vision*, p. 94.

9 Parsons, *Perception*, p. 191.

10 *Ibid.*, p. 192.

rheostats. In order to keep the lighting conditions constant we used a mercury vapour lamp (3 amps.) placed at a distance of 36″ from the motor. The mercury lamp

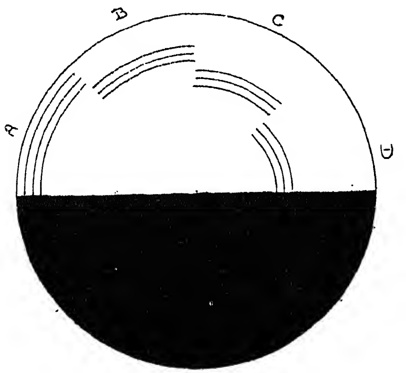

FIG. 1.

Benham's Disc.

was enclosed in a light tight box with an oblong aperture in front, covered by a milk-white glass slide, through which alone light I and II. As the results were the same when light was reflected from and transmitted through the disc, we have recorded here only one set of results. It may be noted here that the replacement of the glass disc by the usual cardboard disc makes no difference to the results.

Parsons rejects the explanations based on contrast mainly on the ground that the colours are seen even when monochromatic light is used. But we had very great difficulty in securing spectroscopically pure monochromatic sources of illumination. Even with the so-called chemical filters of light, the spectroscope revealed a wide range of colours; and with such ordinary sources of monochromatic light as the sodium flame, practically the entire spectral band is visible. It is almost impossible to get a source of pure monochromatic light (unless the spectrum itself is used as the source). The same investigator points out that 'the colours are seen only on the fine lines or on the edges of broader lines if

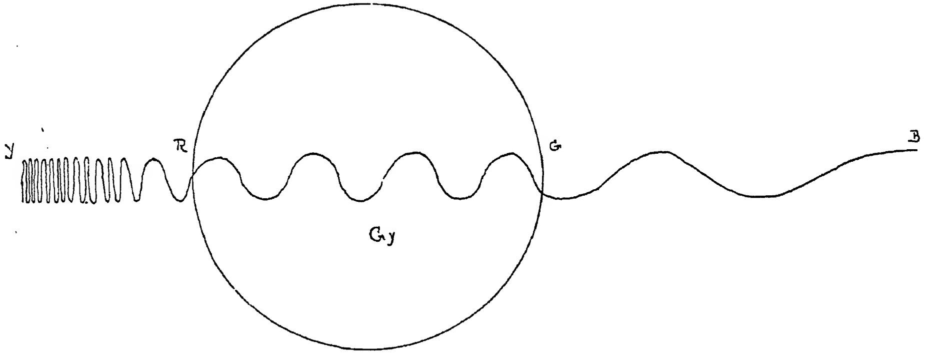

FIG. 2.

Schematic representation of the Hysteresial Hypothesis of Colour Sensation.

Augmentation. *Y*–Yellow, *R*–Red. *Gy*–Grey.

Mediated by the basic rhythm of cells. Damping. *G*–Green, *B*–Blue.

was admitted to the revolving disc. Observations were made in a dark room through a small telescope mounted on a retort stand. Our object in using the telescope was to make it possible for us to observe only one particular set of arcs, cutting out the others, so that any influence of the latter could be eliminated. It must be mentioned at the same time that the telescope did not stand in our way when we wanted to look at the entire disc with the unaided eyes. Our observations are recorded in Tables such be used—never on the white surface'.[11] We found, on the other hand, that not only broad lines, but wide bands were completely coloured. Moreover, the white spaces acquired distinct hues—pink or green—under certain conditions.

The "spatio-temporal pattern" explanation of Pieron is admitted to be the most satisfactory one advanced so far. But in his

[11] Parsons, *Perception*, p. 192.

*Colour Sensations elicited by the Benham Disc with Four Sectors.**

TABLE I.

Speed of rotation (in secs.)	A	B	C	D	Direction of rotation
0·68	violet (deep)	violet (light)	olive-green	black	↻
0·44	violet	violet	green	blue-black ?	↻
0·40	do.	olive-green	green	blue	↻
0·28	do.	do.	do.	do.	↻
		(green most pronounced—inter-spaces green)			
0·21	reddish	green	green	violet	↻

TABLE II.

Speed of rotation (in secs.)	A	B	C	D	Direction of rotation
0·67	black	violet	violet	violet	↺
0·44	do.	olive-green	do.	do.	↺
0·40	do.	green	olive-green	do.	↺
0·29	blue	do.	do.	do.	↺
0·23	violet	do.	green	black & red ?	↺

* The observations were made by the author and by another colleague experienced in advanced spectroscopic research work Mr. N. S. Subba Rao, M.A., Lecturer in Physics, Annamalai University. Neither the author nor Mr. Subba Rao was aware of the Burridge theory when the experiment was conducted.

schematic diagram to illustrate the development of various colours in the different sectors, Pieron has recourse to the tri-colour theory.[12] This theory, we know, is based on objective colour mixtures, but has no foundation in the physiological structure of the retina. All the cones have the same structure, and so have all the rods. Edridge-Green[13] has shown that the function of the rods is to manufacture the visual purple and spread it in the fluid that bathes the cones. We are, therefore, in a quandry if we rely on any one of these multi-chromatic theories. The most satisfactory procedure is to *discard boldly all of them, and seek for a theory which will account for all colour experiences on a* Monistic *basis.* Such a monistic theory is offered to us, for the first time in the history of psycho-physiology, by Professor Burridge.[14]

The colour theories propounded so far have failed, because they have unwittingly started with the assumption that the retinal end-organs are inert structures roused to activity by light stimuli—an assumption which is not true to fact. This extraordinary assumption is the result of assuming that the living cell behaves in exactly the same manner as the muscle-nerve preparation on which the physiologist is wont to experiment with electrical stimuli. Professor Burridge says, ' The action of light on retinal end organs, is precisely that of rhythmical structures, though the due appreciation of this necessarily waited on a further knowledge of the latter's properties.... For there is producible in such structures a

[12] Parsons, *Perception*, Figs. 44–48.

[13] Edridge-Green, *Physiology of Vision*.

[14] Burridge, *Excitability, a Cardiac Study*.

specific type of augmentation, the hysteresial augmentation, of the efforts of rhythmically active retinal end-organs. There is no need for any further special hypothesis to explain the phenomena actually found.'[15]

Every cell in the living organism has a rhythmic activity of its own. The hypothesis of quiescence implicit in current physiological theories is false. The retinal end-organs have a rhythm of their own. The effect of light stimuli is either to augment or damp this inherent rhythm. Augmentation or damping may affect either one or both phases of a rhythmical activity. It may affect the amplitude or the frequency or both. In the former case brightness sensations are mediated, and colour sensation in the latter. Yellow and red are results of augmentation, green, and blue of damping, yellow and blue marking the extreme limits in either case. Grey is the fundamental retinal colour corresponding to the fundamental retinal rhythmic rate. Such in brief, is Professor Burridge's theory so far as it affects our problem.

The Benham phenomenon, which defies explanation on every other theory, lends itself to easy and simple explanation on this theory. When the disc is rotated black and white stimuli alternate in certain given proportions. The result of this alternation is either to augment the inherent rhythm of the end-organ or to damp it. The colours perceived are merely mediated by this hysteresial augmentation of the fundamental rhythm. In the case of our experiment, with the mercury vapour lamp, the result has been damping (except with the highest speed and with one set of arcs). The colours therefore range from violet to green. The damping (or augmenting) effect is due to speed variations, as the change in the direction of rotation merely changes the order of colours.

The theory is simple and true to fact. Other aspects of Professor Burridge's theory dealing with the two sources of energy, and with the nature of the interaction between these two sources have not been touched upon here. But we feel that with this new orientation in physiology many psycho-physiological problems will get solved in a very satisfactory manner.

When we compare the various theories of audition with those of vision we notice a very remarkable difference between them. In the case of the former there is no mention of different cochlear end-organs in order to account for the qualitative differences in the fundamental notes, though these differ as much among themselves as do the various colour sensations. All musical experiences are sought to be accounted for as due to the different types of response of the same kind of end-organ, whereas in the case of colour different end-organs are sought for. The reason for this is plain. The physiologist borrowed the tri-colour theory from the physicist and then attempted to twist the facts in order to make them fit with the unnatural hypothesis. What we need is complete emancipation from the misguiding influence of these multi-coloured and pluralistic theories. Professor Burridge's new physilogical psychology gives us hopes of such emancipation. We find that Benham's phenomenon is one more powerful link in the long chain of evidences adduced by the Professor in support of his new theory of hysteresial augmentation.

In conclusion, I wish to thank my colleague Mr. N. S. Subba Rao for conducting the experiment and for having made it possible for me to secure the valuable results.

---

[15] Burridge, *A New Physiological Psycholgy.*
Burridge, "Colour Vision", *Scientia*, 1934, **56**, 141–151.

Subsoil Water Levels on the Agricultural Research Station, Sakrand.

By R. S. K. I. Thadani, M.Sc., M.Ag., and Dr. B. T. Mulwani.

EARLY in the period of construction of the Lloyd Barrage and canals project, the question of water-logging was brought very prominently to notice by the experience of the Punjab Irrigation Department. In the Punjab, water-logging has, on some older canal systems, become a very serious problem indeed and it has been necessary for the Punjab Government to set up a special organisation for the investigation of water-logging problems and to undertake many expensive drainage schemes with a view to the reclamation of water-logged or damaged lands and the prevention of further extensions of the trouble. The canal systems in the Bombay Deccan, which are fed from storage reservoirs, have also experienced a certain amount of the trouble due to the damaging, or water-logging, of lands as a consequence of irrigation from the canal systems. The experience of both the Punjab and Bombay indicated that similar trouble might be expected in Sind. This indication has led to the investigation of conditions in the areas commanded by the Lloyd Barrage canals to ascertain the possibilities of water-logging following the commencement of Barrage irrigation.

It has been now found out as a result of preliminary investigations by the Research Division of the P. W. D., that a very large area on the Right Bank (about 3,500 sq. miles) in which the predominant crop was Rice, has a high sub-soil water table. This water table is found to vary, yearly, from 3 ft. to 13 ft. below the surface of the ground, the water table being nearest the surface at the end of the irrigation (Kharif) season (*i.e.*, in October) and lowest at the commencement of the irrigation season in June.

In the other areas commanded by the Barrage, notably those on the Left Bank of the river, sub-soil water table has been found

Sub-soil water level in feet above sea-level. (Average of readings from six bore-holes.)

Year	Minimum Water level	Date when the minimum was reached	Maximum Water level	Date when the maximum was reached	Annual rainfall inches	Remarks
1928	70·9	27th May	73·9	17th Sept.	2·00	
1929	68·9	27th May	83·0	7th Oct.	20·36	Abnormal Floods.
1930	77·3	3rd June	86·0	16th Sept.	6·21	Floods.
1931	77·8	1st July	80·2	16th Sept.	3·45	
1932	73·5	16th June	83·5	16th Oct.	6·96	Supply of Barrage Water started from July.
1933	77·8	1st July	81·8	16th Oct.	7·00	
1934	76·2	1st July	80·2	16th Oct.	6·10	
1935	75·2	15th July	77·7	1st Oct.	4·83	
1936	74·4	1st July	76·7	1st Oct.	1·54	
1937	72·3	1st July	74·0	16th Sept.	3·82	

(*N.B.*—The ground-level is approximately 100 feet above sea-level).

to be situated at much lower levels; the problem of possible water-logging is, therefore, considered to be most urgent on the Right Bank.

It was considered necessary to know the result and effect of irrigation water, increased intensity in the cultivation and other factors like seepage, etc. (following the opening of the Barrage canals) on sub-soil water. With this object in view a series of six bore-holes had been struck right across the Sakrand Research Station in 1928. A record of the periodic fluctuations in the sub-soil water levels has been maintained since then. The maximum and minimum levels of the ground water from year to year have been tabulated above.

Examination of the data has shown so far that both the maximum and minimum levels are steadily decreasing after the rise following the supply of the Barrage water. This steady recession of the sub-soil water-level away from the soil surface is a welcome feature, on the left Bank of the Indus. Similar observations will be recorded at the Agricultural Research Station, Dakri on the Right Bank, which has just been started.

Dr. T. S. Wheeler, D.Sc., Ph.D., F.I.C., F.Inst.P., M.I.Chem.E.

THE retirement of Dr. T. S. Wheeler from the Royal Institute of Science, Bombay, is a very real loss to chemistry in India.

Dr. Wheeler possessed unique qualifications and experience as a pure and applied chemist. Educated at the O'Connell School and Royal College of Science, Dublin, he began his professional career as a demonstrator in organic chemistry at the Royal Technical College, Glasgow. He next turned to chemical industry as research chemist at the Royal Naval Cordite Factory, Dorsetshire, and later at the Research Department, Woolwich Arsenal, London. He was then appointed Senior Research Chemist to the Imperial Chemical Industries, a position rarely filled by one of Dr. Wheeler's comparative youth. The outstanding feature of Dr. Wheeler's record as a chemist is his versatility, his publications consisting of over 80 papers in well-known journals embracing every branch of pure and applied chemistry. The width of the range can be judged by his contribution to the theory of liquids on the one hand and his work on the chemistry of coumarins and chromones on the other. He was a D.Sc., a Fellow of the Institutes of Chemistry and Physics and a Member of the Institution of Chemical Engineers, an unusual array of qualifications. During the seven years that Dr. Wheeler spent in India, he established a notable position for himself in the chemical life of the country. He was responsible for the creation and development of a vigorous school of research in physical and organic chemistry in Bombay. The Department of Chemical Technology of the University of Bombay owes a great deal to the enthusiasm, initiative and general technical ability of Dr. Wheeler. As a member of the various committees connected with the creation of the Department and Vice-Chairman of the Board of Visitors, Dr. Wheeler's interest in the Department of Chemical Technology has been deep and abiding. Dr. Wheeler was prominently associated with every scientific organisation in India, being a member of the Publication Committee of the Indian Chemical Society and Vice-President of the National Institute of Sciences and of the Indian Academy of Sciences. In his departure from India, Dr. Wheeler carries with him a keen sense of regret on the part of Indian chemists that his association with them should have been prematurely terminated and every good wish for success and happiness in the new post of State Chemist in Eire, to which he has been appointed.

LETTERS TO THE EDITOR.

Magnetic Properties of Copper Amalgams.

The magnetic behaviour of copper in dilute copper amalgams has recently elicited some controversy. One of us[1] has observed that dilute copper amalgams of low copper content are merely mechanical mixtures of the two metals and the magnetic susceptibility varies from that of pure mercury to that for pure copper. Bates and Tai[2] observed that of all the metals which are diamagnetic in the solid state, only copper retained its diamagnetic character in amalgams of dilute concentrations whereas elements like bismuth became paramagnetic. Recently Venkataramiah[3] has, however, reported that even copper becomes paramagnetic in dilute amalgams. This difference, observed in the magnetic behaviour of copper in dilute amalgams, may be due to the variations in the conditions under which the experiment might have been conducted. Therefore, amalgams were prepared under definite conditions and their magnetic susceptibilities were determined on a Gouy's balance and were checked on magnetic interference balance.

Dilute amalgams containing copper upto 3% were prepared by electrolytes. Pure mercury of $-0\cdot165 \times 10^{-6}$ magnetic susceptibility was used as cathode, and copper sulphate prepared from pure copper of $-0\cdot085 \times 10^{-6}$ magnetic susceptibility was used as an electrolyte. Pure copper sulphate from the stores was not used because even the *Analar* variety was found to contain $0\cdot014$% iron which lowered the susceptibility value of copper and consequently that of the amalgams. It was further observed that when the electrolysis was carried out at room temperatures, the solution became hot and the susceptibility values of the amalgams formed corresponded to those obtained by Venkataramiah, but when the electrolysis was done in an ice-cold solution no lowering in susceptibility value was observed. This difference may be due to the formation of such compounds as copper oxides, because copper has the tendency to get easily oxidised at higher temperatures.

Copper amalgams of higher concentration were not prepared by electrolysis because these took two to three days to be prepared, during which period they hardened and gave low magnetic susceptibility values. Therefore these were prepared by grinding the known weights of pure copper and pure mercury under dilute analytical sulphuric acid in an agate pestle and mortar. Upto 50% the amalgams when freshly prepared are fluids but amalgams of higher concentration are all solids. The magnetic susceptibility value of freshly prepared amalgams whether dilute or concentrated varies from that of pure mercury to that for pure copper. If, however, copper amalgams were kept in air, they hardened and their magnetic susceptibility values fell considerably. For example, in the case of an amalgam, containing 34% copper, the susceptibility fell from $-0\cdot136 \times 10^{-6}$ to $0\cdot071 \times 10^{-6}$ after twelve hours. If this sample was kept in vacuum its susceptibility fell to $-0\cdot119 \times 10^{-6}$. Chemical analysis of these samples

revealed that the hardened black and brittle sample kept in air contained 33·03% copper and the one in vacuum contained 33·98%. The fall in the percentage of copper in the sample kept in air is probably due to the formation of some oxide. Therefore, the greater fall in susceptibility of the sample kept in air seems to be due to the formation of oxide which is known to be paramagnetic. The amalgams were, therefore, kept in vacuum. In spite of this it was observed that they became brittle, their colour showed signs of fading and their magnetic susceptibility values fell from day to day till they acquired constant values. A maximum fall from $-0\cdot136 \times 10^{-6}$ to $-0\cdot047 \times 10^{-6}$ was observed in an amalgam containing 34% copper. Terry and Wright[4] have recorded a change in the crystal structure of copper amalgams on hardening and have suggested the formation of a copper mercury compound in an amalgam containing 34% copper. The fall in the magnetic susceptibility value of copper amalgams on hardening therefore is due to the change in their crystal structure and the maximum deviation at 34% is due to the formation of a compound. A detailed publication on copper amalgams will shortly follow.

S. S. BHATNAGAR.
P. L. KAPUR.
GIRDHARI LAL MITTAL.

University Chemical Laboratories,
University of the Panjab,
Lahore,
November 15, 1938.

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[1] S. S. Bhatnagar and K. N. Mathur, *Physical Principles and Applications of Magneto-Chemistry*, p. 341.

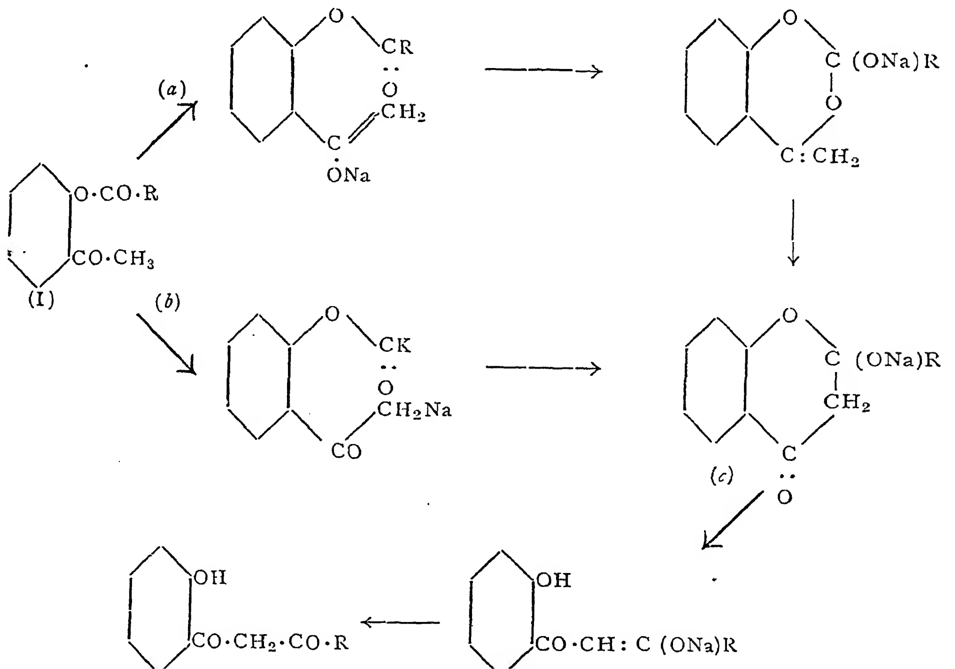
[2] L. F. Bates and L. C. Tai, *Proc. Phys. Soc.*, 1926, **48**, 795.

[3] H. S. Venkataramiah, *Proc. Ind. Acad. Sci.*, 1937, **5A**, 532.

[4] H. Terry and C. W. Wright, *Phil. Mag.*, 1928, **28**, 1055.

Preparation of Flavones from *o*-Aroyloxyacetophenones.

VIRKAR AND WHEELER[1] showed that the Baker-Venkataraman transformation of *o*-aroyloxyacetophenones (I) into the corresponding *o*-hydroxybenzoylmethanes (II), from



which flavones can readily be obtained, could be effected with metallic sodium in ether or toluene. It has now been found that sodium ethoxide in alcoholic solution is a still better reagent for the transformation.

The fact that Claisen reagents are effective is probably significant in regard to the mechanism of the transformation, which in the presence of these reagents, may be regarded as an internal Claisen condensation proceeding *via* (*a*) or (*b*) according as we assume O-Na or C-Na formation; (*c*) corresponds to elimination of an alcohol.

V. V. Ullal.
T. S. Wheeler.

Royal Institute of Science,
Bombay, and
State Laboratory, Dublin,
November 23, 1938.

[1] *Curr. Sci.*, 1938, **7**, 107.

[2] *Cf.* Hückel, *Theoret. Grundlag. der Org. Chem.*, 1934, **1**, 215.

The Presence of Cellulase in Potato Sprouts.

Last month a peculiar case, in which certain potato sprouts bored their ways through cardboard walls of the packages used as potato containers, was observed. A careful examination of the cellulosic material of the cardboard cases showed that the material had been digested and absorbed by the sprouts as there was no indication of rupture due to mechanical force.

This observation was interesting in that the celluloses which are structural substances appear to function as storage materials also in plants. In this connection it was thought that any further evidence regarding the digestive power of potato sprouts would be highly significant. Strausbaugh[1] records a case in which a potato sprout coming in opposition with a tuber in which a wound had been made by a borer continued its growth and emerged on the opposite side of the tuber. The author emphasizes that the storage material was distinctly absorbed as there was no indication of any rupture due to mere mechanical force.

To test the digestive power of potato sprouts, 20 mg. of finely cut pieces of card-board were moistened with sterilized water and 20 ml. of 5 per cent. ammonium carbonate solution[2] was added drop by drop and thoroughly mixed. About 20 vigorously germinating tubers were washed first with mercuric chloride solution (1 : 1000) and then with sterilized water and 1–2 fairly big sprouts together with some potato tissue from the bud-end of each tuber were cut and placed in the flask containing the card-board + ammonium carbonate suspension. Some more sterilized water was added and the flask plugged with sterilized cotton wool and was incubated at 30° C. for 17 days. Portions of the cardboard material were taken out at 3-day intervals and analysed for cellulose content by the Norman and Jenkins[3] modification of Cross and Bevan[4] procedure. Xylan was also estimated on isolated cellulose samples. Xylan content is obtained from the furfuraldehyde yield of the isolated cellulose by reference to Krober's tables. Furfuraldehyde yield was obtained by distillation with 12 per cent. HCl and precipitation as phloroglucide. The data obtained in this connection are presented in Table I.

Table I.

Decomposition of Cellulose by Potato Sprouts.

Time Interval days	Cellulose content gms.	Xylan content gms.
0	12·72	3·23
3	12·01	3·02
6	11·78	2·78
9	11·01	2·47
12	10·87	1·88
15	10·78	1·30

It is evident from the data that a greater percentage of loss in cellulose is attributable to the loss of xylan—a cellulose which is associated with most celluloses. It appears that xylan, being in all probability, less

resistant than cellulose, is mainly, digested by potato sprouts.

B. N. Singh.
P. B. Mathur.
M. L. Mehta.

Institute of Agricultural Research,
Benares Hindu University,
August 18, 1938.

1 Strausbaugh, *Plant Physiol.*, 1929, **4**, 157.
2 Hutchinson and Richards, *J. Min. Agr.*, 1921, **28**, 398
3 Norman and Jenkins, *Biochem. J.*, 1933, **27**, 818.
4 Cross and Bevan, *Cellulose* (London), 1918.

Green-Seeded Gram (*Cicer arietinum* L.) in Central Provinces.

An exhaustive collection of local grams from all over the Central Provinces and Berar is in progress at the Oil Seeds Research Station, Nagpur. In the samples collected so far, a new type of gram was noticed. It is chiefly characterised by the presence of variable grades of green coloured seed-coat. This gram is reported to have been observed in 1932–33 by one Laharia, a cultivator of the village Bagaspur in Narasinghpur Tahsil, C.P., in a field of D 8 gram (*Gulabi Chana*). Subsequently it was tried on a large scale by one Choudhary Moolchand of Gotegaon and since then the area under this gram has been rapidly increasing due to a very high price it fetches in the market. The estimated area in 1936–37 has been reported to be 1,500 acres in that tract.

During the year 1937–38 this type was tried at the Government Experimental Farm, Adhartal. The seeds obtained bred true in respect of the various grades of green seed-coat. A few seeds of this type were sown during the rainy season of the current year for some experimental purposes at the Oil Seeds Research Laboratory and were observed to be breeding true. The plants were harvested when fully matured and the seeds obtained were healthy and showed cent. per cent. germination. The green condition, therefore, does not represent an early stage of maturity of any gram type.

The chromosome counts were made from the root-tip cells which showed $2n = 16$ (Fig. 1). In temporary aceto-carmine preparation eight bivalents were clearly observed at I metaphase in polar view. chromosome number in this species has been

Fig. 1.
Somatic chromosomes in green-seeded gram (*Cicer arietinum* L.). $2n = 16$.

reported to be $2n = 14$ by Rau.[1] Dixit[2] studied the chromosomes of the Pusa types 1, 2, 18 and 25; in the first two types (the "Kabuli" gram types) the chromosome number was observed to be $2n = 16$ while the remaining two (the "Deshi Gram" types) showed $2n = 14$. In a giant mutant form of type 22 the chromosome number was recorded as $2n = 16$ by Dixit.[3]

The senior author is indebted to the Imperial Council of Agricultural Research for financing the Oil Seeds Research Scheme, Nagpur, where this work is being carried out.

R. H. Richharia.
R. J. Kalamkar.

Oil Seeds Research Laboratory,
Nagpur,
November 8, 1938.

1 Rau, N. S., *Jour. Ind. Bot. Soc.*, 1929, **8**, 201–206.
2 Dixit, P. D., *Ind. Jour. Agri. Sci.*, 1932, **2**, 385–390.
3 Dixit, P. D., *Ibid.*, 1932, **2**, 391–408.

On the Occurrence of *Isarachnactis* in the Arabian Sea.

Early in 1935, Mr. S. Jones, of Trivandrum handed over to me a small collection of a certain larval Ceriantlid which he obtained in August 1933, from the neighbourhood of Kovilam on the Travancore coast. Detailed study of these specimens could not then be attempted owing to other preoccupations. Recently, I have obtained specimens of the same form collected off the coast of Alleppey and Ambalapuzha in Travancore, and with the material gathered from the three localities, I have been able to make a fairly complete study of the anatomy of this interesting Cerianthid,

from serial sections as well as dissections of the specimens.

These Ceriantlids are from 20 to 30 mm. long (inclusive of the tentacles) and from 4 to 6 mm. broad; and they are of an yellowish brown colour in the preserved state. In the earlier stages, the tentacles are almost as long as the body, and occasionally even longer, but in the older stages the column is comparatively more prominent. There are both marginal and oral tentacles; the latter are much smaller than the marginals and occur close to the stomodæal opening. The directive and the two adjoining chambers are provided with oral tentacles.

In view of the absence of botrucnidæ and the occurrence of acontia, the larvæ belong to the family Arachnanthidæ and they have the general appearance of *Dactylactis* and other allied genera. The presence of oral tentacles corresponding to the early protomesenterial chambers, definitely indicates that the larvæ in question belong to the genus *Isarachnactis* Carlgren. This fact is also borne out by other anatomical details like the structure of the syphonoglyph, the nature of the mesenteries, and origin and position of the acontia.

The genus *Isarachnactis* is known from two species, *I. lobiancoi* (originally described as *Arachnactis lobiancoi*) from the gulf of Naples[1] and *I. longipes* obtained by the German Deep Sea Expedition from the neighbourhood of Gibralter.[2] The genus is so far known only from the Mediterranean, and its occurrence in the Arabian Sea, as far down as the Travancore coast, is an interesting new information in connection with its distribution.

Detailed accounts of the anatomy and systematics of this interesting Ceriantharian will be published elsewhere.

N. Kesava Panikkar.
Madras Christian College,
Tambaram, and
Department of Zoology,
University of Madras,
December 2, 1938.

1 Carlgren, O., "Über Ceriantharien des Mittelmeers." *Mitt. Zool. Stat. Neapel*, 1921, **Bd. 20**, 356–394 and Pl. 15-17.

2 Carlgren, O., "Die larven der Ceriantharien, Zoantharien und Actiniarien," *Wiss. Ergebn. Deutschen Tief-See Expedition, Valdivia*, 1924, **Bd. 19**, Hft. 8, 341–475 and Pl. 1-6.

The Chromosome Complements in Eight Species of Locustidæ.

We have investigated the chromosome complements of eight species of Locustidæ mentioned in the following table. The specimens from which testes were dissected out and fixed were collected from two localities, near Gujarat College, Ahmedabad, North Gujarat and Jogeshwari about 20 miles north of Bombay. Both these localities are situated in the Bombay Presidency, Western India. The accompanying table also contains the main particulars, namely the diploid number, the number of V-shaped elements and the X-chromosome as shown in the accompanying figures of the spermatogonial complexes of the species investigated.

Table.

	Diploid chrom. Number	No. of V's contained	Shape of X-chrom.
Subfam. Phaneropterinæ			
1. *Ducetia japonica* ..	29	..	R
2. *Elimæa securigera* ..	27	1	V
3. A sp. of Phaneropterinæ	31	..	R
Subfam. Mecopodinæ			
4. *Mecopoda elongata* ..	27	5 (at least)	V
Subfam. Pseudophyllinæ			
5. *Sathrophyllia* sp. ..	35	..	R
Subfam. Conocephalinæ			
6. *Conocephalus* sp. ..	33	5	V
Subfam. Listroscelinæ			
7. *Hexacentrus mundus*	31	1	V
8. *H. annulicornis* ..	(31)	1	V

R = rod-shaped chromosome; V = V-shaped chromosome.

In *Hexacentrus annulicornis* (No. 8), the diploid number is inferred from the haploid condition observed in the primary spermatocyte.

In every species studied the sex-chromosome, the x-element is either V-shaped or has

the form of a rod. And in the first spermatocyte division this X-chromosome exhibits a

FIG. 1.
Ducetia japonica.

FIG. 2.
Elimœa securigera.

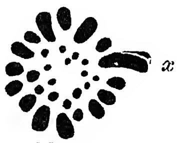


FIG. 3.
A species of *Phaneropterinæ.*

FIG. 4.
Mecopoda elongata.

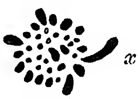


FIG. 5.
Sathrophyllia sp.

FIG. 6.
Conocephalus sp.

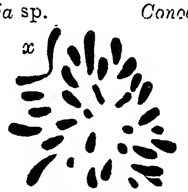


FIG. 7.
Hexacentrus mundus.

All are from spermatogonial metaphases, × 1500.
x : X-chromosome.

conspicuous precession by running towards the pole of its side ahead of other autosomes in course of separation. This seems to be a remarkable characteristic of the chromosomes of the Locustidæ in comparison to those of the Acrididæ, as in the latter group this behaviour of the X-chromosome of primary spermatocytes in division is not so marked.

In other respects too the Locustid chromosome complements show a marked contrast to those of the Acrididæ. The former group displays a wide range of variety in the constitution of its chromosomal garniture even among the members of the same sub-family, while in the Acrididæ the chromosomal complements do not deviate much and are more or less uniform in the various sub-families.

A full account of these observations will be published elsewhere.

J. J. ASANA.
S. MAKINO.

Gujarat Colege, Ahmedabad,
and Hok. Imp. Univ., Japan.
December 1, 1938.

A Note on Gametogenesis in a Few Members of *Sterculiaceae.*

LITERATURE on the members of *Sterculiaceæ* is very scanty, but for the works of Cheesman (1927), Kuijper (1914), and Heyn (1930), on *Theobroma Cacao*, and Gioelli (1932) on some European species like *Brachychiton acerifolium.* The following is a short account on the gametogenesis of a few members of the family, namely, *Pterospermum reticulatum* W. and A., *P. heyneanum* Wall, *P. acerifolium* Willd., *Sterculia acerifolia* A. Cunn., and *Helicteres isora* L. The detailed paper will be published elsewhere.

The ovules have two integuments in all, and in *Helicteres isora* the nucellus is exposed due to the incomplete development of the two integuments (Fig. 1).

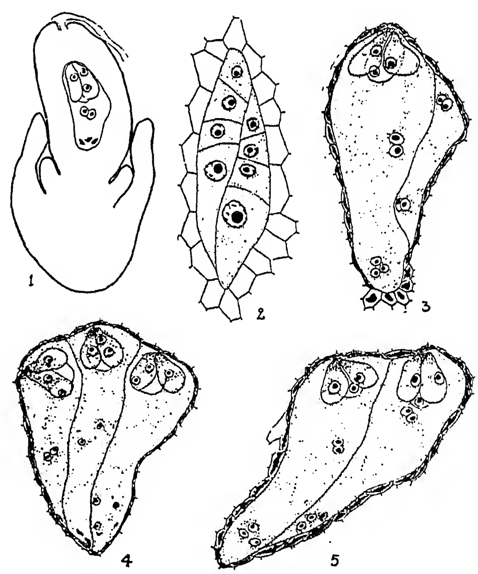


FIG. 1.—Ovule of *Helicteres isora* at the time of fertilization. × 266·7.

FIG. 2.—Double tetrads of megaspores in *Pterospermum acerifolium.* × 600.

FIG. 3.—Double embryo-sacs in same. × 266·7.

FIG. 4.—Triple embryo-sacs in same. × 186·7.

FIG. 5.—Double embryo sacs in same. × 266·7.

(Original magnifications are indicated; reduced in reproduction to approximately one-third.)

The primary archesporium is hypodermal in origin and consists of a single cell in *Sterculia acerifolia* and *Helicteres isora*, and a

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number of cells in the species of *Pterospermum*. A number of parietal layers are formed and the megaspore-mother cells become deeply situated in the nucellus. Only one megaspore-mother cell is functional in all except in *P. acerifolium*, where two or three develop further. The formation of a linear tetrad has been observed in all. In *P. acerifolium*, due to the activity of two or three megaspore-mother cells, more than one tetrad is formed (Fig. 2).

The usual course of development follows and the normal eight-nucleate embryo-sac is formed. Gioelli (1932) working on some members of Sterculiaceæ, reports the occurrence of six-nucleate embryo-sacs, but such a case has not been found in any of the plants studied now. In *Pterospermum acerifolium* the multiple tetrads develop into double and triple embryo-sacs (Figs. 3, 4 & 5). The occurrence of double and triple embryo-sacs is reported for the first time in the family.

Meiosis in the microspore mother cells of *Sterculia acerifolia* and *Pterospermum reticulatum* has been studied and the haploid chromosome number in both is nineteen.

The author expresses his sincere thanks to Dr. M. A. Sampathkumaran, M.A., Ph.D., and Prof. L. Narayana Rao, M.Sc., F.R.M.S., for suggestions and guidance.

Y. M. LAKSHMINARAYANA SHARMA.

Department of Botany,
Central College,
Bangalore,
December 3, 1938.

Cheesman, E. E., "Fertilization and embryogeny in *Theobroma Cacao*," *Ann. Bot.*, 1927, **41**, No. 161.

Gioelli, F., *Contributo Alla Conoscenza Del Gametofito Femmineo E del Polline Nella Famiglia Delle* Sterculiaceæ, 1932.

Heyn, A. N. J., "Die Befruchtung bei *Theobroma Cacao*," *Proc. Akad. Wet. Amsterdam*, 1930, **33**, 533–41.

Kuijper, J., "Die Entwicklung des Weiblichen Geschlechtsapparates bei *Theobroma Cacao*" (*Rec. trav. Bot. Neerl.*, 1914, **11**, 37–43).

Albinism in Mustards.

MUSTARD work has been in progress for the last six years, and there are 132 strains isolated from different species of cultivated Brassicas—*Brassica juncea* H.F. and *Brassica campestis* L., *Brassica Napus* I *Brassica nigra* Koch, *Brassica rugoja* Prai A few albinatic plants appeared this ye for the first time. It was interesting find that these were confined to one stra of the lines of *Brassica Napus*. Cotyledo in these palnts are normal and green wh the subsequent leaves are complete albinatic and much reduced in size. T plants on the whole are very delicate. they survive and are able to give some see it will be interesting to study the inheritan of this character in their offsprings.

T. S. SABNIS.

Cawnpore,
November 19, 1938.

Gynura crepidioides Bth. in China an Hainan.

THE record of this vigorously spreadi weed from the mainland of Asia,[1] h been recently extended by Bor[2].

Among a collection of duplicates recent received at Buitenzorg, I found specimens *Gynura crepidioides* Bth. which represent as far as I know—the first appearance China and Hainan, both collected in 19 In the preliminary identifications it w mistaken—as is often the case in herbaria for *Erechthites hieracifolia* Rafin.

The localities are the following:

China. Hunan Prov.: Ma-Ling-Tu Sinning Hsien, Oct. 16th, 1935, C. S. F Y. V. Li No. 618, herb 2–3 feet tall, alo shaded streamside, 600 m. alt.

Hainan. Po-ting, April 1935, F. C. H 71591, herb on roadside flowers red.

C. G. G. J. VAN STEENIS.

The Herbarium, Botanic
Gardens,
Buitenzorg, Java,
November 15, 1938.

[1] *Curr. Sci.*, 1938, **7**, 21.
[2] *Ibid.*, 1938, **7**, 116.

REVIEWS.

The Chemical Studies of P. J. Macquer. By Leslie J. M. Coleby. (George Allen & Unwin, Ltd., London), 1938. Pp. 129. Price 6*s*. net.

Dr. Coleby's admirable contribution to the History of Science Library edited by Prof. A. Wolf, gives a happy picture of the discerning and industrious French chemist, Pierre Joseph Macquer (1718–84), whose eminence was recognised by his contemporaries more clearly than by the present generation. The reason for this may possibly be the fact that, although dying only ten years before Lavoisier was beheaded, Macquer remained a phlogistonite, believing that phlogiston was combined light, instead of combined fire as held by G. E. Stahl (1660–1734) developing the views of J. J. Becher (1635–82).

He was one of the first chemists who observed the formation of water when hydrogen is burned (before October, 1776), but even in 1778 still considered water, along with air, fire and earth, to be the only elementary substances. He took the Newtonian view of heat as a state of rapid motion among the ultimate particles of a hot body. He was the first to isolate arsenic acid (before 1766), although the credit for this has always gone to Scheele (1775). Succeeding Hellot as director of the dyeing industries, Macquer made valuable contributions to the practice of this art, and had clear views regarding its underlying principles, recognising that the purely mechanical theory of Hellot was insufficient to explain the facts. As director of porcelain manufacture at Sèvres, also in succession to Hellot, he emulated J. H. Pott (1692–1777) who was employed by the King of Prussia to ascertain the constituents of Meissen ware, improving Pott's furnace, and conducting a ten years' course of laborious experiments which led, in 1769, to the perfect porcelain.

Macquer's great contribution to science, however, lay in his *Dictionnaire de Chymie*, first published in 1766, and appearing as a greatly augmented revised edition, occupying four volumes octavo (over 2,000 pages) in 1778. During his life-time the fabric of chemistry had completely changed, and the dictionary finally dispelled any lingering mists of alchemy: it was preceded by his *Elémens de Chymie Théorique* (1749) and *Elémens de Chymie Pratique* (1751), superseding Lemery's *Cours de Chymie* (1675), a practical handbook of preparative pharmacy. The dictionary was a chemical best-seller, the first edition undergoing translation into German (1768), Danish and English (1771); whilst the second edition was translated into German (1781–83) and Italian (1783–84). The chemical foundation of the first edition was phlogiston, and at the revision closing in 1776 Macquer was called upon to decide whether he could accept the new ideas of Lavoisier. He chose a dispassionate compromise, the strictly non-committal aspect of which is condensed in the following quotation from the Preface .... "None of thep ropositions....which I myself indicate as principles, because of the great many facts which support them, must be taken as literally or necessarily true." How different would be the complexion of our lives if political champions were equally detached.

Many of Macquer's researches were published in the Memoirs of the Academy, and the remainder incorporated in the dictionary: among the former will be noted by the curious a contribution on "white gold" or platinum, one pound of which had reached Baumé from a friend in Madrid (1757). The source of this windfall was Mexico, and the two chemists interested themselves in its properties. The Spanish Government had placed an embargo on its production and export because it could be used for debasing gold, and in 1788 were buying platinum at eight shillings a pound, presumably for that purpose.

The current generation has witnessed advances in chemical science as dramatic as those of any other period, and involving profound alteration of chemical outlook. It is restful and informative to review the more leisurely mental processes of the eighteenth century, and the present estimate of a colleague and older contemporary of Lavoisier, for which gratitude is due to Dr. Coleby, is carefully planned and agreeably presented.

M. O. F.

Annual Review of Biochemistry. Vol. VII. Edited by James Murray Luck (Annual Reviews, Inc. Stanford University, P.O. California), 1938. Pp. vii + 571. $5·00.

Biological chemists all the world over eagerly await with keen interest the appearance of this Annual Review and have become accustomed to find contributions relating to the most outstanding topics of the day, critically appraised by the foremost exponents in the field. The present volume fulfils these expectations to a generous degree.

The Editors have been fortunate in securing the services of some of the ablest men for reviewing the topics and this success is largely due to the untiring efforts of Dr. Luck who, often, takes a trip to Europe with the object of establishing personal contacts with all the possible reviewers.

When there is so much, which is excellent, it is difficult and perhaps invidious to discriminate. But we feel tempted to invite attention to the appropriateness of an article by Lohmann on the chemistry and metabolism of the compounds of phosphorus closely following his brilliant discovery that co-carboxylase is diphosphorylated vitamin B_1. It is indeed thoughtful of the Editors to have arranged for having a contribution on Vitamin-B Group by Peters and his colleagues, who had long established an intimate connection between vitamin B_1 and the decarboxylation of pyruvic acid.

The chemistry of amino-acids and proteins is reviewed by Bergmann who has substantially contributed towards the elucidation of the structure of proteins. Authoritative is the contribution of Mitchell on nutrition and so are those of Boysen Jensen on the growth regulations of plants, of Krebs on the metabolism of amino-acids and proteins, and of Lundsgaard on the biochemistry of muscle.

Newer Methods of Volumetric Chemical Analysis. By Erna Brennecke, N. Howell Furman, Hellmuth Stamm, Rudolf Lang and Kasimir Fajans. Wilhelm Boettger, Editor. Translated by Ralph E. Oesper. (Chapman & Hall, Ltd., London), 1938. Pp. xiii + 268. Price 18/6.

As the title suggests, the book is a symposium on new methods of volumetric analysis in which are dealt with, in seven parts: (1) Elimination of titration errors, (2) Ceric sulphate as oxidizing agent, (3) Alkaline permanganate titrations, (4) Iodate and bromate methods, (5) Chromous solutions as reducing agents, (6) Oxidation and reduction indicators, and (7) Adsorption indicators. Each of the sections is written by an authority on the subject. According to the Editor the topics have been treated with two objectives in mind: (*a*) exposition of the theory underlying the new method, so that an insight may be gained into the reasons for the way in which the subject has been developed, and (*b*) the presentation, so far as possible, of an exact set of directions for the performance of particular analysis. It may be pointed out that the book is not meant for a beginner, and is not meant to supplant existing text-books on volumetric analysis. Only an analytical chemist, who is conversant with existing processes, can follow these newer methods with benefit.

As most workers are aware, ceric sulphate as an oxidising agent is a serious rival to potassium permanganate. The chief advantages claimed for ceric sulphate are, firstly, its stability even at boiling temperatures; secondly, that it can be titrated in presence of HCl, and thirdly, the simplicity of its reduction product, *viz.*, $Ce^{++++} \rightarrow Ce^{+++}$. Even though in some cases, for example, organic acids (p. 46), the stoichiometric relations do not hold good, to practical chemists the result matters most, and so long as that is satisfactory, the theoretical aspect is only of secondary importance.

Similarly, recognition is sought for chromous solutions as against titanous, as reducing agents for potentiometric titrations. The reducing power of Cr^{++} is very much greater than that of Ti^{+++}. (The normal potentials of the two are $-0·41$ volt and $-0·04$ volt respectively.) This excellent property from the theoretical point of view has its drawbacks in practice; chromous solutions are very sensitive to atmospheric oxygen and so should be prepared and stored with extreme care, and titrations should be carried out in an atmosphere of CO_2. The necessary directions are given in detail.

The critical discussion of the behaviour of a number of "Redox" (presumably an American abbreviation for "reduction-oxidation") indicators should be extremely helpful to every student of chemistry, theoretical and practical. Similarly the

numerous applications of the various processes compiled at the end of each section will be welcomed by all analysts.

The final chapter on adsorption indicators is refreshingly new, and is treated in the lucid style of Prof. Fajans, who was the originator of this method of volumetric work. First developed by him in 1923, it has attracted a number of workers, and more than 60 papers have appeared since then, including five from India. The author himself points out that these indicators do not always indicate the exact equivalence point, and hence can only be of limited application. In the case of single radicals, for example the halides, the method is very good, while mixtures give trouble, and the experimental conditions have to be carefully worked out. This chapter would have been more helpful if fuller details had been given of experimental conditions for each estimation. The Bibliography is comprehensive enough, but not every worker has immediate access to the original literature.

The book is to be welcomed as a useful supplement to existing works of reference, and may be regarded as an excellent contribution to the recent advances in volumetric analysis.

M. R. N.

The Fundamental Principles of Quantum Mechanics, with Elementary Applications. By Edwin C. Kemble. (McGraw-Hill Publishing Company, Ltd., London), 1937. Pp. 611. Price 36*s*.

Within the brief space of a decade the science of Quantum Mechanics has grown rapidly due to the united labours of mathematicians and physicists, and now bids fair to oust the classical ideas from the field of Physics. Though we have to thank the Institution of Physicists for its basic ideas, a really satisfactory presentation and a rigorous formulation of the whole subject now require mathematical methods of the type unfamiliar to most students of Physics. Nor can it be said that all the uncertainties and the dark corners have been completely cleared up and illuminated by the mathematicians. In spite of the attempts of the various physicists, it is difficult, nay even impossible, to clothe the fundamental ideas of the new mechanics in a language familiar to the classical physicists. The genial idea of the wave-packet alluring in the first instance has come out insufficient on closer analysis, and though a statistical interpretation of the wave-theory seems to be the only one satisfactory from the philosophical standpoint, the methods of this new Statistics are not the same as those of the classical kinetic theory. It is also desirable that the beginners should be made aware of the defects that still exist in an otherwise imposing structure, and attempts should be made to familiarise the students of Physics with the abstruse mathematical ideas of Neumann and Dirac, by presenting the main outlines of the subject in a compact and attractive form.

The regrettable tendencies in most textbooks of the subject to gloss over difficulties, have induced the author to write a textbook which aims at a rigorous formulation of the fundamental principles, and tries to explain at length all the novel mathematical ideas, essential for a proper understanding of the subject. The book begins with a historical introduction and gradually leads up to modern statistical ideas: Typical problems of wave-mechanics are worked out at length to illustrate the peculiarities of the new method and the reader is familiarised by easy stages with the idea of orthogonal functions, and with operational methods. The author has taken every care to explain all novel ideas, and it is hoped that the beginners who work through Chapter IV of the book will master the essentials of the new analysis. The fundamental problem of the hydrogenic atom, and of the diatomic molecules are next dealt with at great length, which thus prepare the reader for a proper appreciation of the extension of the method to the many particle problems. The author has devoted a considerable portion of the book to familiarise the reader with the operator-method of Von Neumann. Neumann's own book on the subject is too difficult for any but the most mathematical; nevertheless it is necessary that the physicists should be familiar with the basic ideas of his mathematical theory, in order that he may appreciat^ how the philosophical difficulties of the subject are attempted to be removed.

The matrix methods, and the theory of perturbation are also treated at some length, and the book ends with an introduction to the theories of the electron-spin, the many

electron-problems and to the exchange phenomena.

The Appendix contains a good deal of mathematical material which will minimise a too frequent consultation of mathematical reference books. However for the benefit of his more curious readers, the author has also given numerous references to original papers which deal with the matter in more detail.

The author is to be congratulated on having thus tackled a formidable task in an eminently satisfactory fashion. Like most of the other useful books of the international series in Physics, it removes a long-felt want, and will help the cause of Physics by making an abstruse but important subject attractive and readable by a masterly exposition. S. N. B.

The Principles and Practice of Lubrication. By A. W. Nash and A. R. Bowen. (Chapman & Hall, Ltd., London), 1937. Pp. 345. Price 18*s*. net.

This book, as its name implies, deals with the principles and practice of lubrication. There is hardly any machine or mill the success of which is not partly dependent on lubrication. For successful lubrication, science is going to play even a more important part than it has hitherto done. It is not only the design and composition of bearings, essentially engineering problems, but the characteristics of oils and the mode of their applications which physico-chemical investigators must determine, that will help in the definition and the solution of the much vexed question of 'oiliness'.

The contents of this book have been divided into ten chapters:

(1) Introduction.
(2) Friction.
(3) Specific Gravity and Viscosity.
(4) Design and Lubrication of Bearings.
(5) Source of Lubricants.
(6) The Chemistry of Lubricants.
(7) Chemical and Physical Tests for Lubricating Oils.
(8) Industrial Lubrication Practice.
(9) Mechanical Friction Testing Machines.
(10) The Care of Lubricants.

There is an appendix which provides some useful physical data and tables and a subject index. The absence of a separate name index is not particularly noticeable as unfortunately this book does not deal with the subject in a historical manner nor has it aimed at giving the most recent information on the subject which is available in literature. The high pressure lubricants which are attracting a great deal of attention, particularly in America, have hardly been described. The book is particularly weak from the point of view of theory.

The chapter on the design and lubrication of bearings is well written and the book presents all that is generally known to the chemists working in the oil of refineries. It has tried to add very little new to the stock of their knowledge from modern publications. The chapter on sources of lubricants contains valuable information and helps in understanding the part which solvent refining plays in obtaining a good lubricant.

The book will prove of great help to those who wish to be acquainted with the general principles of lubrication without having to go into greater details. The reviewer has no doubt that the new edition will aim at a more ambitious production and if the theory and the mathematical portions are extended and the recent work on high pressure lubricants is more fully dealt with, this book will become one of the important publications in the oil literature which has been greatly enriched by the work of Ellis and Dunstan and his collaborators during recent yeers. The get-up of the book and the presentation are good. S. S. B.

Eugen Jahnke and Fritze Emde.—Table of Functions with Formulæ and Curves. By B. G. Teubner. (Leipzig and Berlin), 1938. Third (Revised) Edition with 181 Figs. Pp. 305. Cloth R.M. 15—less 25% abroad.

This wonderful book of tables whose text is written in two languages, German and English, side by side, is now in its third edition. The first 78 pages of the second edition have now been deleted. The author (Mr. Jahnke, the original joint author, is now not living) has felt that these pages comprising the tables of the more elementary functions should not appear along with the tables of the higher functions, and he promises to bring forth a separate book for these elementary functions. The present edition is however smaller than the second edition only by 25 pages, showing that more than 50 pages of extra matter have now been introduced. The chief additions are in the tables relating to the

complete elliptic integrals of the first and second kind wherein tables have been added for other than the Legendre forms, and in the tables relating to the Weber-Lommel and Struve's functions. Also, formulæ and graphical representations are given for the confluent hypergeometric functions and for Mathieu functions.

It will be presumptuous on my part to describe the salient features of "Jahnke-Emde Tables of Functions" which by now must have forced its attention on every student of function theory. It is, no doubt, true that the usefulness of the Tables will be most appreciated by practical computers whose work involves these higher mathematical functions. But every student and teacher of the theory of functions must now realize that his study of the subject must include besides the formal analytical development, a proper grasp as regards the exact graphical and pictorial conception of these functions. To quote from the Preface of the previous edition, "In every text-book of differential calculus it is regarded as essential to illustrate the nature of simple functions in the real domain by means of curves". The most important contribution of the book, so far as pure mathematicians are concerned, is in its opening their eyes to show that such a process is equally desirable in the study of functions in the complex domain.

C. N. S.

Charts for Design of Timber Beams. By V. M. Limaye. (Published by the Forest Research Institute, Delhra Dun), 1938.

The charts prepared by Mr. V. M. Limaye will be very useful for engineers who are called upon to design structures out of timber. As again timber seems to be becoming more and more popular, these charts will be of considerable help to designers as the dimension for the beams can be arrived at easily in a few seconds, thus saving time and labour. It would have been more interesting if the author had given a short note on the formulæ used and on the construction of the charts themselves.

These charts should find a place in the library of every building Engineer.

E. K. R.

Text-Book of Biology. By C. J. George, Wilson College, Bombay. (Published by the Author), 1938. Price Rs. 7–8.

With the introduction of the Bifurcation Scheme by the Bombay University whereby the student takes either a Science course or an Arts one from the very first year of his College career, a good number of books on Biology by different teachers in the Colleges affiliated to the Bombay University have appeared. Many of them are scrappy, badly brought out and full of mistakes. These faults are due either to the haste with which they were brought out or due to the lack of capacity of the authors to write them properly.

As such, it is a pleasure to find occasionally a book on Biology which is well written, nicely printed and handsomely brought out at a comparatively low price of Rs. 7–8–0. Such is the book of Dr. George which combines in it several advantages over other Indian text-books on Biology and I commend it both to teachers and students of the Bombay University.

This is perhaps the first Indian text-book which deals both with Botany and Zoology courses for Intermediate Science Course. This is a distinct advantage to the student in that it costs him less. Within the short space of 440 pages the author has very successfully covered both the Botany and Zoology courses for Inter Science Examination and even added two more chapters on Heredity and Organic Evolution. Thus the book is a very comprehensive work and we may say that the author has practically left nothing untouched, or that could be desired for an elementary student of Biology. Another important feature of the work is that the author has added personal observations, on Yeast, Moss, etc. Not only this but he has included separate sections on physiology wherein he leads the reader to the study of biochemical changes occurring in the germination of seedlings.

In the end, however, may be mentioned two faults: (1) the figures in the chapter on Plant Physiology which on the whole are very good, are badly drawn; (2) a chapter on Plant Ecology would greatly enhance the value of the book. We congratulate the author on his achievement and wish that many more such comprehensive books would be published by the author.

F. R. B.

The Indian Sugar Industry (1938 *Annual*). By M. P. Gandhi. (Gandhi & Co., Calcutta), 1938. Pp. 300. Price Rs. 2–4–0.

This publication like its predecessors by the same author, abounds in statistical information about the progress of Indian Sugar Industry during the year 1938. The data are presented alongside the corresponding figures for the previous years and enable the reader to make a thorough comparison.

The essential texts of the various Acts of the Government of India and the Provincial Governments of the U.P. and Bihar, relating to the protection and control of Sugar Industry are given in the beginning of this monograph. Following this is a compilation of 37 tables—Sugar Industry at a glance—containing numerous industrial data. This is a very useful and ready reference for the readers. In the end of this section the author has given an interesting forecast of Tariff Board's recommendations, the publication of which is expected shortly.

The main text is divided into two parts and contains a very detailed treatment of the various aspects of Indian Sugar Industry. The author has freely quoted from different authorities and has advanced his own views and arguments on the many questions relating to the industry and its problems.

Indian Sugar Industry has made rapid progress in the last five years during which period the country has been able to attain self-sufficiency in her sugar requirements. In fact, the white sugar production has just reached the country's needs for consumption and is raising problems of checking over production, and economic manufacture of sugar, to enable profitable exportation. This publication by Mr. M. P. Gandhi comes in very opportune, giving as it does a complete account of the industry's progress during these years.

The book is recommended for one and all interested in Sugar Industry

G. G. R.

The Design of Weirs on Permeable Foundations.*

THE design of weirs on permeable foundations has been thoroughly dealt with by Rai Bahadur A. N. Khosla, Dr. N. K. Bose, Dr. E. McKenzie Taylor and their colleagues in the present Publication No. 12 of the Central Board of Irrigation, India. Exhaustive investigations have been carried out by the authors, with the result that they are now able to present a fairly complete solution of the complex problem which is supported by data from prototypes in the field, models in the laboratory and by mathematical theory.

Until recently Bligh's Creep Theory was being adopted for designing weirs with component parts on sand or alluvial soil. This theory has been found to be defective from actual field observations and new formulæ have been evolved by the authors. The design of weirs on sand foundations which was hitherto based on assumption can now be worked out with exactness in a rational and scientific manner.

The publication consists of eleven chapters. Chapter I is mainly historical and traces the development of the science of subsoil hydraulics as related to weir design on permeable foundations from the earliest times to the present day. The earliest formula was given by H. D'Arcy for the flow of water through permeable solids in 1856 and the validity of the same was tested by Col. Clibborn in 1896. The investigations carried out by Col. Clibborn, Sir John Benton and others formed the first rational basis for the design of weirs on sand and they gave the idea of failure by undermining and uplift due to flow of water through the subsoil of the weir. Sir John Ottley and Thomas Higham developed from the results of experiments conducted by Col. Clibborn what is known as 'The hydraulic gradient theory' which came to be generally accepted in India. Bligh who originally believed that the stability of a weir depended on its weight, became subsequently converted to the hydraulic gradient theory and his enunciation of this theory is known as Bligh Creep Theory. This theory stated that the

* *Design of Weirs on Permeable Foundations.* By R. N. Khosla, N. K. Bose and E. McKenzie Taylor. Published by the Central Board of Irrigation, Simla, 1936. Pp. 178.

length of the path of flow had the same effectiveness length for length, in reducing uplift pressures whether it was along a horizontal or a vertical line. Following Buckley, he assumed the percolation water to creep along the contact of the base profile of the weir with the subsoil losing head *enroute*, proportional to the length of its travel. He called the loss of head per unit length the 'Percolation gradient'. The importance of vertical cut-offs at the upstream and downstream ends was lost sight of by him. The actual pressures indicated by pipes inserted in the floors of some of the weirs disclosed great disparity between those observed and calculated by this theory.

Chapter II deals with the theory of seepage flow, D'Arcy's law and its extensions as obtained by Schlichter. It is shown in this chapter how Schlichter's equation agrees with the well-known Laplace equation, which governs the steady flow of heat and electricity through a conductor and of a perfect fluid. It is established that the problem of flow of water through the subsoil is analogous to that of the flow of a viscous fluid or that of electricity through a conductor. This discovery of the analogy has led to the solution of the various problems connected with seepage flow.

The fundamental differential equation is given by Laplace as:

$$\frac{\delta^2 p}{\delta x^2} + \frac{\delta^2 p}{\delta y^2} + \frac{\delta^2 p}{\delta z^2} = 0.$$

It is thus shown that in the problem of subsoil flow the determination of equipressure surfaces is identical with that of the equipotential surfaces in the problems of the steady flow of electric currents through conductors.

Chapter IV describes the experimental verification of the potential law applicable to the flow of water through permeable homogeneous subsoils by means of models. Experiments with both hydraulic and electric models prove that the flow net of equipressure and stream lines for any particular weir profile is independent of (1) class and structure of subsoil so long as it is homogeneous; (2) scale or size of structure; (3) temperature so long as it is uniform throughout the medium; (4) applied head; and (5) upstream and downstream water levels. Conclusions 3, 4 and 5 have been arrived at from a study of the pressure observations at the Panjnad Weir.

Chapter V describes the erection of pressure pipes in Khanki Weir, Panjnad Weir, etc. The study of pressures in the Panjnad Weir is stated to have been the first experiment of its kind in the world and it has been instrumental in furnishing the final solution to the complex problem of weir design on sand foundations. In this chapter, the location of pressure points, precautions to be taken in the erection of pressure pipes, the observations to be made and the instruments used are explained in detail.

The method of recording observations made, standard forms to be used, and plotting of values obtained in the form of graphs are also described.

Chapter VI is devoted to the comparison of results obtained from models of Panjnad Weir, Khanki Weir, Lloyd Barrage, Deg Escape Head, etc., and their prototypes. A large amount of data is presented to prove that models can reproduce exact field conditions and the results obtained from models can be accepted as a safe guide for the designing of weirs. It is also shown how the actual observed uplift pressures do not exceed 82 per cent. of the designed pressure and there is thus a factor of safety provided by nature. The effect of silt and scour at the upstream and downstream of pervious floors and the difference in temperature of the river water and the subsoil are discussed. Silt upstream will reduce uplift pressures and that downstream will increase them. Similarly scour upstream will increase uplift pressures and scour downstream will reduce them. The latter may however lead to dangerous conditions eventually.

Chapter VII deals with the mathematics of weir design. The determination of uplift pressures and exit gradients for a number of cases of floors with pile lines in different positions below the floors is worked out mathematically. A number of tables and charts for different values and conditions are given in detail. A summary of Mr. J. K. Malhotra's mathematical investigations of the subsoil flow under two standard forms of structures consisting of a single depressed floor without aprons and a pair of equal sheet piles placed at the heel and toe of a flush floor is appended to this chapter.

Chapter VIII discusses the question of exit gradients as related to weir design.

The failure of a weir on sand from a seepage flow can occur by (1) undermining of the subsoil and (2) uplift due to pressure under the floor being in excess of the weight on the floor. The failure from the undermining of the subsoil which usually starts from the tail end of the work is the most common. Its causes and measures to prevent such failure are therefore discussed in detail. The investigations prove the absolute necessity of having some depth of piles or vertical cut-off at the tail end.

One general feature which is noticeable in all the experiments is that the insertion of a pile anywhere results in heading up or increase of pressure upstream and a reduction downstream, the increase or reduction being maximum at the pile and decreasing rapidly farther off. The main influence is confined to a radius equal to the depth of the pile. At twice the radius the influence becomes negligible.

The last chapter discusses principles governing the design of weirs in relation to the flow of water over the surface. The subject of surface flow is still lacking in researches and the design is based on empirical formulæ which may require to be modified in the light of investigations to be conducted in future. In subsurface flow, the chief factors which govern the design of weirs are (1) uplift pressures and (2) exit gradients. But in the case of surface flow the additional factor of dynamic impact has to be considered. The design in this respect will depend upon (1) the afflux, (2) the changes in the regime of river, (3) the discharge per foot run, (4) flood scour, and (5) the position and depth of the trough of the standing wave. The material discussed in this chapter represents the accumulated experience in the field supplemented by a limited amount of experimental investigations. The great need for further research in regard to surface flow is emphasised.

The book contains a large number of tables, graphs, diagrams and photographs of experiments which are highly interesting and useful in following the theoretical calculations. The authors and their colleagues deserve to be highly commended for their excellent work.

V. G.

OBITUARY.

Pandit Hemraj.

PANDIT HEMRAJ, Principal, Dyal Singh College, Lahore, whose untimely death is being mourned in all circles, was born in Daffar, a village in the Hoshiarpur District of the Panjab, towards the end of the year 1886. His father Pandit Ganga Ram who survives him is a poor Brahmin. It was under hard circumstances, therefore, that Pandit Hemraj received his education. He passed his middle school examination from the S.D. School, in 1903, and his matriculation from the Government High School, Hoshiarpur, in 1905. He passed his B.A. and M.A. examinations from the D.A.V. College, Lahore, with distinction, standing first in the first class in the M.A. examination in 1912. Shortly after passing his M.A., Pandit Ji was appointed in October 1912, an Assistant Professor of Mathematics in the Dyal Singh College, Lahore. Pandit Ji's work thus came to the notice of the Panjab Government and Sir John Maynard, the then Vice-Chancellor of the Panjab University, moved the University to offer him a scholarship to go abroad for higher studies. The offer was not accepted for reasons of health. By hard work Pandit Ji rose to the Principalship of the College in 1921, and served it ably till the time of his death on the night of the 12th November 1938. His death has left a void in the academic life of the Panjab University.

HANSRAJ GUPTA.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(*University Librarian, Madras*)

Nicoll, Whitlock (1786–1838)

WHITLOCK NICOLL, a British physician, was born at Treddington, Worcestershire, in 1786. His father who was rector of the parish died when Whitlock was but two years. He was educated by his uncle. He took his M.D. degree May 17, 1816 and became an extra-licentiate of the College of Physicians, London.

His Publications

He became a regular contributor to the *London medical repository* in 1819. His first book entitled *Tentamen nosologicums* classified diseases into (1) febres, (2) neuroses and (3) cachexiæ. In his *History of human economy* (1819) he developed a physiological approach to clinical medicine. *Primary elements of disordered circulation of the blood* (1819), *General elements of pathology* (1820), and *Practical remarks on the disordered states of the cerebral structures in infants* (1821) were his other books. Three of his papers on defective vision attracted some attention in his days.

His Honours

He became a member of the Royal Irish Academy in 1821 and was elected Fellow of the Royal Society in 1830.

After successful practice in London for about twelve years, he retired in 1835 and died December 3, 1838.

Overton, John (1764–1838)

JOHN OVERTON, a British writer on chronology, was born at Thetford, Lincolnshire in 1764. He got appointed in the excise.

Interest in Astronomy

He had a strong liking for astronomy. He constructed his own telescopes for his observations. His interest swerved to biblical chronology by about 1817 when he published the *Geneology of Christ with a new system of sacred chronology and the true meaning of the weeks in Daniel.* 2 V. In 1820 he brought out his *Books of Genesis and Daniel* (*in connection with modern astronomy*), *etc.* Two other books of his on related topics were *The chronology of the apocalypse investigated and defended* (1822) and *Strictures on Dr. Chalmers's discourse on astronomy* (1823).

Overton died at Chelsea December 1, 1838.

Hunt, Robert Woolston (1838–1923)

ROBERT WOOLSTON HUNT, an American metallurgist, was born at Fallingston, Bucks County, December 9, 1838. Having served in his father's drugstore for some time, he found employment for several years in an iron rolling mill.

First Analytical Laboratory

Having taken a course in analytical chemistry, he established in 1860 the first analytical laboratory as an integral part of an iron works at the plant of Canbrie Iron Co.

Bessemer Process

In 1865 this Company sent him to their plant at Wyandotte, Michigan where experiments were being made with the Bessemer Steel Process. In 1867 Hunt rolled for the Pennsylvania Railroad with Bessemer steel from the Pennsylvania Steel Company, the first commercial order for steel rails. From 1871 to 1888 he was in charge of Bessemer steel plants in several companies, until he established at Chicago the firm of Robert W. Hunt & Company. His *History of the Bessemer manufacture in America* published in the *Transactions* (1877) of the American Institute of Mining Engineers is an authoritative contribution.

Rails

He invented the very widely adopted rail mills. He was Secretary of the American Society of Civil Engineers which designed the rail section bearing the Society's name. In 1921 he proposed a new rail section and the nick-and-break test for soundness of each ingot.

His Honours

In 1912 he was awarded the John Fritz Medal and in 1923 the Washington Award. There have been established in his memory the Robert W. Hunt Medal and the Robert W. Hunt Prize awarded annually by the American Institute of Mining and Metallurgical Engineers.

Hunt died at Chicago July 11, 1923.

Burnham, Sherburne Wesley (1838–1921)

S. W. BURNHAM an American Astronomer was born at Thatford, Vermont, December 12, 1838. Having served in the army during the Civil War, he practised shorthand by himself and acted as official court reporter at Chicago for over twenty years. Though his days were fully occupied in taking down the court reports and writing them out in long hand, his tireless energy was such that he would carry out a full programme of astronomical observations at night. He worked at the Lick Observatory from 1888 to 1892 and was the first senior astronomer at the Yerkes Observatory from 1897 to 1914.

How He turned to Astronomy

When he was shorthand reporter at New Orleans, one afternoon as he was strolling along the street he heard a book auctioneer crying Burritt's *Geography of the heavens*. He bid for the book which was knocked down to him. On examining it he found it contained a chart of the sidereal heavens. In these he soon became interested and he bought a small telescope. By 1886 he got a better instrument and he also came in possession of Webb's *Celestial objects for common telescopes*. This determined his future line of work.

Double Stars

His chief fame rests on his work on double stars. It was then generally supposed that the Herschels had left no more double stars to be found. But Burnham's keen eye detected many stars with only a small fraction of a second of arc. His observations which were of the highest accuracy were made with great rapidity. He is said to have measured as many as one hundred double stars in one night. The total number of stars listed by him is 1,340.

His Publications

His results were published from time to time in several periodicals, the *Monthly notices* and the *Astronomische Nachrichtem* being the chief of them. But the most famous of his works is the *General catalogue of double stars within* 120° *of the north pole* 2 V. (1906).

History of the Catalogue

This *General catalogue* has a very interesting history, which is best told in the author's own words: "This catalogue in its first form was the result of my own needs soon after acquiring the six-inch Clerk refractor in 1870. From the beginning that instrument was devoted almost entirely to the observation of double stars. Objects were constantly found which could not be identified in any of the books....At that time there were but few books in Chicago bearing upon the subject of double stars....At that time to make a complete catalogue of the then known double stars, it was necessary to first make pen copies of nearly everything required for this purpose. These were secured by visiting libraries of the naval and other observatories and by borrowing books from various quarters. In this laborious way manuscript copies were acquired of the material parts of nearly all publications relating to double stars.... The manuscript general catalogue was kept continuously posted to date by the addition of all new stars and new measures from current publications. In order to make room for this new material a second manuscript edition became necessary and still later a third."

This went on till 1905 when the then newly established Carnegie Institute of Washington undertook to publish the *General catalogue* as the fifth of its publications. The book gives full data of about 13,665 double stars.

Burnham died at Chicago March 11, 1921.

INDUSTRIAL OUTLOOK.

A Method of Preparing Palmyra Jaggery for Refining.

By Victor M. Hinchy, M.Sc., F.I.C.

THE production of Jaggery in India is an age "old institution, a cottage industry" to be fostered and one which may rightly take its place in the internal economy of the country.

The sale of this commodity to factories for refining purposes is of increasing importance and it is in the interests of the producer and refiner alike that unnecessary loss should not occur during the interval between the purchase of the raw material and the manufacture of the finished white sugar.

Inversion of sucrose during this interval benefits neither producer nor manufacturer, yet the present system is to stock the raw material in godowns, more or less open to the elements, for a period of six to nine months to allow the mother liquor or runnings to drain from the crystals.

That such inversion does occur has been demonstrated, but the considerable loss involved has scarcely been appreciated.

In an attempt to determine the causes of deterioration, a series of experiments were initiated. These consisted in submitting samples of jaggery to pressure in desiccators containing (1) concentrated sulphuric acid, (2) 40% formaldehyde, (3) distilled water. Pressure was continued for a period of three months.

The result calculated on the basis of 100% solids are given below :—

It is obvious from these results tha jaggery is pressed under perfectly conditions, it not only does not deterio during a period of several months, but by elimination of the impurities in the mo liquor, the refining value of the raw mat is increased considerably.

Since however it would be difficult maintain these conditions on a commer scale, the effects of pressure for a sl period only were investigated.

A screw press of the type used in bag analysis, was employed and the jaggery analysed after six hours continuous press The results obtained may be summarise follows :

(1) Over 11% of the original weigh jaggery was expressed as 'runnings'. T is a fair average figure for the quan usually removed during storage for months or more.

(2) 7·1% only of the original suc present in the jaggery was removed in runnings.

(3) 54% of the invert. sugar passed of the jaggery.

(4) 33·5% of the soluble ash was fou in the runnings.

(5) The refining value of the jagg calculated to 100% dry matter increa from 66·10% to 73·94%.

Finally, a jaggery pressed during a pe of a few hours would be superior to t

	Original Jaggery	Jaggery pressed over H_2SO_4	Jaggery pressed over HCHO	Jaggery pressed over H_2O
Pol.	86·02	89·74	64·90	17·32
Invert sugar	2·74	1·77	1·25	16·03
Soluble ash	3·90	2·06	1·38	2·44
Insoluble matter	3·74	4·93	19·84	31·43
Other non-sugars	3·60	1·50	12·63	32·78
R.V.	63·78	77·67	56·75	– 10·91
Weight of original jaggery ..	354·80	354·8	354·8	354·8
Weight of final jaggery	..	334·1	97·6	31·4
Percentage of Solids removed ..	..	5·8	72·5	91·1

ordinarily melted and thus would be considered an excellent raw material for the refinery.

The type of large-scale equipment required for this purpose is a hydraulic press with interleaves of metal between the cakes of jaggery. One press at each centre for the purchase of jaggery would deal with the material as it arrives, the treated jaggery being sent on to the refinery for immediate melting and the runnings being resold direct to the ryots.

ASTRONOMICAL NOTES.

Planets during January 1939.—Mercury is a morning star and will be at greatest elongation (22° 49′ W.) from the Sun on January 3. Venus will continue to be a bright object conspicuously visible in the eastern sky for nearly three hours before sunrise; the stellar magnitude will be about −4·2. On January 30, the planet reaches greatest elongation from the sun (46° 56′ W.). Mars is moving slowly eastwards in the constellation Libra and can be observed in the latter part of the night. On January 15, there will be a close conjunction of the planet, with the Moon the distance between them being only about one-third of a degree.

At sunset, Jupiter will be low down in the western sky, while Saturn will be visible as a first magnitude star slightly west of the meridian. The ring ellipse is beginning to widen, the angular dimensions of the major and minor axes being 39″·4 and 5″·9 respectively. Uranus will be on the meridian at about 7 p.m. and can be easily located, being only about a degree north of the fifth magnitude star σ Arietis; on January 22 it will be at one of the stationary points of the geocentric orbit. The moon will closely approach the planet on January 1, and again on January 29.

Jupiter's Satellites X and XI.—From observations secured at Mt. Wilson, Dr. Paul Herget has derived an orbit for J. XI (*U.A.I. Circ.* 730) which indicates that the satellite is moving round the primary in a retrograde direction. The eccentricity is 0·21 and the period 692·5 days. The elements of the orbit computed for J. X. agree very closely with those of the sixth and the seventh satellites of Jupiter. These newly discovered objects are extremely small bodies having probably diameters not exceeding 5 miles.

The Variable Star R Coronæ Borealis.—This is a peculiar variable star which is normally of constant brightness (6th magnitude) but occasionally becomes faint, abruptly dropping several magnitudes in brightness. After an interval which is never uniform, the star gets brighter and resumes its original brightness. On 1938 October 30, the star was observed to have declined to magnitude 9·4 and on November 2 to magnitude 10·5 (*U.A.I. Circular* 731). The last minimum occurred in December 1934 when the star's magnitude dropped to 10·4.

T. P. B.

ANNOUNCEMENT of the brightest stellar object ever discovered has been made by Dr. Fritz Zwicky, astrophysicist of the California Institute of Technology in association with Dr. Walter Baade of the Mount Wilson Observatory staff. This brilliant supernova, tentatively called *I.C. 4182*, was located by means of the 18-inch Schmidt Telescope at the Palomar Observatory. It is apparently of a luminosity about 400,000,000 times that of the sun.—*Sky*, 1938, **3**, 30.

RESEARCH ITEMS.

A Light Filter for the Isolation of the Mercury Green Line.—The green line of the mercury arc is the most intense in the mercury spectrum and it permits of excellent Raman spectra to be taken of photochemically sensitive substances, those which fluoresce when exposed in the blue region or coloured substances which show absorption in the region. Aqueous cupric chloride solution to which concentrated hydrochloric acid or chlorides have been added shows absorption in the blue and red region and transmits 5000–6000 Å. Addition of neodymium chloride to the above solution greatly narrows the range on both sides and transmits sharply about 5460 Å. For Raman measurements according to Stoll (*Ber.*, 1938, **71**, 1576) one uses a 5 mm. thick layer of a semi-saturated solution of neodymium chloride to which 20 per cent. wt. (on water used) of cupric chloride has been added. This solution transmits 80 per cent. green and less than 0·1 per cent. of yellow and blue, and nothing of red, violet and ultra-violet. A saturated solution of neodymium chloride transmits the green line 100 per cent. Hence one can also saturate the above solution with neodymium nitrate or didymium nitrate before use. It is a clear, transparent and stable solution.

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Polycyclic Aromatic Hydrocarbons.—The polycyclic aromatic hydrocarbons are of importance as parent substances of steroids, œstrogenic and carcinogenic substances. Their synthesis and properties have engaged the attention of Ch. Weizmann and E. Bergmann (*Scripta Academica Hierosolymitana* Scientific Report, 1938, **1**, 1–28). In the synthesis of anthraquinone derivatives by condensing phthalic anhydride with aromatic hydrocarbons, Weizmann introduced useful modifications by suggesting the use of boric acid instead of aluminium chloride and interaction with Grignard compounds, good results being obtained with dihydroxy-naphthacene-and-pentacene quinones. A method based on allyl-benzenes isomerising to hydrindenes and butyl-benzenes into tetrahydronaphthalenes has been employed by the authors for obtaining a lower homologue of rubrene. The authors suggest a more probable formula for *iso*rubrene of Mureau and Dufraisse. The possibilities of the diene methods and those of I. G. Farbenindustrie based on removal of HCl from chlorostillbenes have been extensively studied by the authors. X-Ray investigations have shown rubrene molecule to be not flat like many known hydrocarbons. Another topic of interest dealt with by the authors is the formation of naphthafluorene type of aromatic hydrocarbons from steroids by dehydrogenation.

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During the boiling of sulphited syrup in the vacuum pan sulphur dioxide always escapes but the beneficial effect on the white colour of the sugar is still derived. This is due to the fact that a sulphited syrup reduces the colour absorption by the sugar at the graining point. It is pointed out that the resulting colour of the sugar is largely determined by the colours absorbed at the point of graining; during the growth of crystal, colour absorption takes place only to a very small degree. It is therefore recommended that the syrup employed for granulation must be maintained at a high degree of sulphitation (pH 5·2–5·4) and in the later stages of boiling, less acidic syrup can be employed.

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For the reasons mentioned above regarding the absorption of colours by sugar at the granulation stage, the practice of mixing molasses with sulphited syrups for graining is to be disapproved.

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A section of considerable potential interest to India was that on "Storage of Fruit and Vegetables". The main speaker did not deal much with tropical fruits, but this lack was made good by the communication of Dr. Wardlaw of Trinidad, already well known to tropical workers from his series of papers on cold storage, in the *Journal of Tropical Agriculture*. He stressed the need for finding the best stage of maturity and the best temperature for each kind of fruit and pointed out that the long transport that had to be endured by tropical fruit meant a higher storage temperature and an earlier stage of maturity at picking. He emphasised the need to get tropical fruit into store as quickly as possible to avoid wound parasites and to prevent the onset of ripening due to the warm environment, and pointed out that well-equipped shipping was a fundamental requirement.

It is impossible to deal even slightly with the many admirable communications, but mention must be made of the paper by Dr. Hatton (East Malling, England) on "The Present Status of Research on Rootstock Plants and the Use of Rootstock Plants," in which he traversed a field where his own experiment station has given a brilliant lead. During the discussion on this paper, Mr. Naik dealt with rootstock problems in mangoes and citrus species and mentioned the fruit research schemes subsidised by the Imperial Council of Agricultural Research.

During the Congress one member of the Indian delegation visited the world-famous Plant Breeding Institute founded by the late Prof. Edwin Baur at Müncheberg, and another visited the Horticultural Experiment and Research Institute at Dahlem.

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The Indian delegation to the Horticultural Congress consisted of Dr. W. Burns (Agricultural Expert, Imperial Council of Agricultural Research), Dr. H. Chaudhuri of the Punjab University, and Mr. K. C. Naik, B.Ag., M.Sc., Superintendent of the Fruit Experimental Station at Kodur (Madras). As the Congress was divided into no less than 20 sections, the three delegates arranged as far as possible to attend different sections, in order to give and get as much information as possible. All, however, attended the session of the Tropical Section of the Congress, of which Dr. Chaudhuri (at the invitation of the German organisers of the Congress) had the honour to be the first president and to deliver the presidential address. During the discussion Dr. Burns gave an account of the organisation of horticultural research in India.

All meetings were held in the Kroll Opera House, which has, in addition to its main great auditorium, many rooms of all kinds which were used for the sectional meetings, and for some of the social events. The opening meeting of the Congress was held in the great auditorium which was decorated for the occasion with that colour and lavishness that one expects from a régime that has perfected the art of mass displays. Behind the rostrum was a vast map of the world; against it were ranked the banners of over fifty nations, and in the centre was suspended an enormous golden rose, the symbol of the Congress, also worn on the badges of all delegates.

Arrangements had been made for all meetings held in this hall and also in some of the smaller rooms whereby delegates could hear any speech in any one of four languages: German, Italian, French or English. This was done by a system of interpreters each speaking into a telephone while the listener had at his seat another telephone and a switch that enabled him to listen to any one of these interpreters.

The Congress was officially opened by the Reich Minister for Food and Agriculture (Herr R. Walther Darré) who welcomed the delegates and pointed out how the International Horticultural Congress had grown from small beginnings to be the forum of horticultural specialists from all parts of the world. He emphasised the fact that there is scarcely any field of activity so varied as horticulture, proceeded to point out the increasing importance of fruit and vegetables in world trade and human diet and remarked on the number of new problems that all this had raised. He also stressed the cultural significance of horticulture (for the Congress had several sections dealing with the cultural and æsthetic side of the subject).

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Among the sectional papers, a notable one was that of Mr. Charley of Long Ashton (England) dealing with fruit beverages of the unfermented group, a subject of much interest to India, and one in which considerable headway has been made at the Agricultural College in the Punjab (work jointly financed by the Punjab Government and the Imperial Council of Agricultural Research).

A section of considerable potential interest to India was that on "Storage of Fruit and Vegetables". The main speaker did not deal much with tropical fruits, but this lack was made good by the communication of Dr. Wardlaw of Trinidad, already well known to tropical workers from his series of papers on cold storage, in the *Journal of Tropical Agriculture*. He stressed the need for finding the best stage of maturity and the best temperature for each kind of fruit and pointed out that the long transport that had to be endured by tropical fruit meant a higher storage temperature and an earlier stage of maturity at picking. He emphasised the need to get tropical fruit into store as quickly as possible to avoid wound parasites and to prevent the onset of ripening due to the warm environment, and pointed out that well-equipped shipping was a fundamental requirement.

It is impossible to deal even slightly with the many admirable communications, but mention must be made of the paper by Dr. Hatton (East Malling, England) on "The Present Status of Research on Rootstock Plants and the Use of Rootstock Plants," in which he traversed a field where his own experiment station has given a brilliant lead. During the discussion on this paper, Mr. Naik dealt with rootstock problems in mangoes and citrus species and mentioned the fruit research schemes subsidised by the Imperial Council of Agricultural Research.

During the Congress one member of the Indian delegation visited the world-famous Plant Breeding Institute founded by the late Prof. Edwin Baur at Müncheberg, and another visited the Horticultural Experiment and Research Institute at Dahlem.

The social entertainments by the Reich Government and by the Central Association of

German Horticulturists were enjoyable affairs and also led to a great number of useful personal contacts. These personal contacts are one of the most valuable results of such international congresses. The man one meets is no longer a mere name but a person with whom one can have a correspondence with friendship and understanding behind it.

From this Congress has been gained a series of summaries of the present state of knowledge in horticulture and also useful details in many branches of horticultural practice. India's horticultural problems and achievements were presented and many friends made. Lastly, India had the chairmanship of an important section.

W. B.

SCIENCE NOTES.

The Mohenjodaro Civilization.—The work executed during the four seasons 1927–31, detailed accounts of which are given in a recent publication entitled "Further Excavations at Mohenjodaro" by Dr. Ernest J. H. Mackay, has thrown more light on the life of the ancients who peopled the Indus Valley 5,000 years ago. The presence of the Indus Valley seals in Sumarian cities, points to the trade connections between the two countries. The city's sanitation appears to have been very carefully looked after. A mound, proved to be a heap of rubbish, has been discovered, at some distance from the area occupied by the houses, showing that the idea of removing rubbish was being acted upon. Relics of the playful pastimes of children has been unearthed; carts of pottery pulled by toy bullocks are among the interesting finds made as a result of the excavations.

* * *

Assam's Coal Resources.—Recent investigations by the Geological Survey of India, mainly concerned with the unravelling of the structure of the rocks and incidentally with the continuity of the coal seams, have revealed the existence of workable coal in the south-eastern part of the Garo Hills and South-western area of the Khasi Hills, in Assam.

There appear to be two main seams of coal—an upper, varying from 18 inches to 4 feet, and a lower, varying from 3 feet to over 6 feet. The upper is relatively inferior while the lower seam is of good quality coal.

Presuming the coal seams to be continuously present under the areas indicated, it is computed that the reserves of coal, in the low seam only, average about 75,000,000 each in the Langrin and Nongstoin areas within a depth of 500 feet of the surface, and probably over 500,000,000 tons in the area south of the Tura range west of Chutmang mountain, at depths from 200 to 1,000 feet.

The Daranggiri coalfield reserves are estimated at 75,000,000 tons with coal lying at depths of 300 to 400 feet. In all these cases expensive boring must be carried out to prove the lower seam, and coal will ultimately have to be worked from shafts varying from 200 to perhaps 800 feet deep, and in most cases a railway or ropeway communication should constitute an important consideration.

* * *

India's Educational Problems.—The Wardha Education Scheme was the main subject of deliberation before the Central Advisory Board of Education, which met in New Delhi on December 3, 1938.

In January, 1938, the Board appointed a Sub-Committee under the chairmanship of the Hon'ble Mr. B. G. Kher, Premier and Education Minister, Government of Bombay, to examine the scheme of educational reconstruction incorporated in the Wardha Scheme in the light of the Wood-Abbott Report on General and Vocational Education and other relevant documents. This Sub-Committee met in Simla in June last and submitted its report to the Board on December 3, 1938. The Board generally approved the recommendations.

The Sub-Committee first attempted to clear the misunderstandings and misconceptions which had gathered round the Wardha Scheme and then considered its various aspects. In its opinion, these misunderstandings had arisen from either a misconception of the fundamental ideas on which the scheme rests or from the statements made by its enthusiastic but misguided protagonists or from some of the phraseology of the Zakir Husain Report itself which is the authoritative Wardha Scheme of Education. The Sub-Committee observed that the Wardha Scheme as presented in the Zakir Husain Report was one of education through activity and not of production as is generally believed, and that this scheme was in full agreement with the recommendations made in the Wood-Abbott Report so far as the principle of learning by doing was concerned.

The Sub-Committee discussed whether or not it was possible to teach through the basic craft all subjects to the standard anticipated. There was general agreement that in the lowest classes education could be satisfactorily carried out through activities, but certain elements of cultural subjects which could not be correlated with the basic craft must be taught independently. Again, spinning and weaving should not be the only basic craft but any craft of equal or higher educative possibilities could be taught. Stress was laid on the report of the Sub-Committee on the training of teachers, the raising of their status and pay, etc. While generally approving these recommendations, the Board decided that copies of the Sub-Committee's report should be forwarded to Provincial Governments for consideration.

The Sub-Committee did not consider the question of financing the Wardha Scheme as this was outside its terms of reference, nor did it make any recommendation as regards the coordination of this scheme with higher education. To examine these questions of finance and coordination and certain other matters arising out of the Wardha Scheme, the Board appointed another Sub-Committee of which the Hon'ble

Mr. B. G. Kher, Premier and Education Minister, Government of Bombay, is to be the Chairman.

Another subject of considerable importance that engaged the attention of the Board was the problem of adult education and illiteracy. It was explained that some provinces were now beginning to make serious attempts towards the removal of adult illiteracy. The Board felt that this was one of the most important problems to be examined on an all-India basis. It accordingly appointed a Sub-Committee with Dr. Syed Mahmud as Chairman to examine this problem carefully and to report to the Board in due course.

* * *

The Malaria Survey of India, 1927–1937.—The history of Malaria research in India during the early years of the present century and the scope and activities of what is to-day known as "The Malaria Institute of India", has been described in a recent pamphlet issued by the Director of the Institute. While acknowledging the valuable contributions by such pioneers as Christophers, Bently, Fry, Graham, Hodgson and Sinton to the epidemiology of malaria in India, special mention is made of the work by Sinton and his collaborators on quinine and Totaquina in the treatment of malaria and the work of Taliaferro and Mulligan on the Histopathology of malaria. A chronological review of the Malaria Surveys conducted by the members of the Staff is given with a useful classified list of publications at the end.

Important amongst the several activities of the Institute is the annual malaria class, for giving both theoretical and practical training in Malariology to members of the medical and public health professions.

B. A. R.

* * *

The Annual Report of the London Shellac Research Bureau for the financial year 1937–38, which has been issued by Mr. A. J. Gibson, Special Officer, Lac Inquiry, constitutes an interesting and valuable document.

The total lac exports from India to foreign countries suffered a serious fall by about 21 per cent. Although we are assured that this fall is not discouraging as it has been shared by many other commodities from India and elsewhere, we feel that it would be advisable to investigate the cause of this substantial and serious reduction in the export of lac which is peculiarly susceptible to the danger of either total or partial replacement by synthetics. The ruling market rates of lac. at the moment, are below the cost of production and immediate steps should be taken to stimulate the market.

Mr. Gibson has continued his work as Special Officer, Lac Enquiry, with characteristic enthusiasm and energy. He has popularised the employment of lac in Industry by lectures, by establishing personal contacts with specialists and manufacturers, by contributing articles and reviews to the technical press and participating in most of the International Exhibitions in Europe.

Regarding competition from the synthetic resin industry, it is pointed out that "as research work in lac expands it becomes more and more apparent that for certain uses synthetic resins hold the field and will continue to hold the field". Synthetic resins for example, will dominate the field of mouldings of the closed mould type; lac cannot hope to compete with resins of high melting point and those which exhibit outstanding weather-resisting properties. Encouraging results have, however, been obtained with injection mouldings using various lac moulding powders. This line of work should be more intensively and more systematically pursued. Attention should be drawn to the successful preparation of a "Hard lac resin"-urea-micronised-mica-filler injection moulding powder by Messrs. The Metropolitan-Vickers Electrical Co., Ltd., to the manufacture of jute boards bonded with shellac, and to the process of hot-spraying of powdered lac.

* * *

Jute Substitutes.—According to the information contained in the *Bulletins* of the Indian Central Jute Committee, a new company called Compania De La Juta E Di Fibre Similare D'Etiopia has been floated with a starting capital of 10,000 Lire. The intention of the prime movers of this project, is to cultivate fibres which can serve as substitutes for jute in East Africa.

The Department of Agriculture, South Africa has been experimenting with Brown Hemp, or *Hibiscus canabinus*, indigenous to South Africa, for some years and have arrived at the conclusion that this annual, which often reaches a height of 7 feet, can be cultivated on a wide scale and used as a substitute for jute. *Hibiscus bifurcatus*, a native plant of Brazil, has been found to be useful as a substitute for jute in that country.

A new type of heavy paper suitable for the manufacture of sacks has been made by Dr. Tunji Torii, Chief Chemist of the Japanese Bag Company, Tokyo. The product is reported to be better than hemp or leather, in resisting water and sand, and it is claimed that its strength increases when left in water for prolonged periods. In Munchukuo, *Kenaf* is being cultivated on a large scale with a view to eventually substitute it for jute.

In Belgian Congo, *Urena Lobata* and Punga fibres, which were introduced in 1930, have achieved a position of relative importance as substitutes for jute.

Rosella is being cultivated in Java, and *Rosella* bags are being extensively employed in the sugar trade in the place of jute bags. It is expected that unless unforeseen circumstances arise, Java will become self-supporting in 3–4 years, at least so far as sugar bags are concerned.

* * *

Cell Adoption to Poisons.—A report on the presence, in living animals, of a mechanism through which the cells are enabled to resist poisoning by changing their structure, was presented by Prof. William D. MacNider, Dean of the Faculty of Medicine, North Carolina, at the Autumn meeting of the National Academy of Sciences, U.S.A. (*New York Times*, October 26). The resistance against poisons developed in the livers and kidneys of animals, is not specific to

any one substance. It is produced as a result of the change in the structure of the tissues. When uranium nitrate is administered in doses large enough to injure the cells of the kidney and liver, the cells elaborate a defensive mechanism by building at an entirely new type of cell, flattened in shape and smaller in size, and possessing a resistance not only against uranium nitrate but also against mercuric chloride, chloroform and alcohol. These new cells resemble certain types of embryonic cells, known to resist these poisons. Similar cells have been observed in senescent animals indicating that a similar process takes place naturally in the aging animal as part of a natural defence against the ravages of life.

(By the kind courtesy of the Editor, *World in Brief*, New York.)

* * *

Beneficial Insects of Mysore check Fruit Fly Menace in Australia.—Dr. Gurney, Entomologist, New South Wales, Australia, visited Mysore State during July, August and November-December of 1935 and made a special study in the Entomological Laboratory of the Agricultural Department of cetain Hymenopterous parasites of the fruit flies of a variety of cultivated fruits as well as a number of those occurring wild; some three species of the common indigenous fruit fly, Chætodacus infesting specially guavas, solanum and sandal berries, were found to be subject to the attacks of two varieties of Hymenopterous parasites I. Opius (Braconidæ) and Syntomosphyrum (Chalcidæ) and a fair percentage of the fruit fly maggots were noticed to be naturally controlled. Dr. Gurney had most active collaboration from the Entomological Section of the Department of Agriculture, Mysore State, and sent several consignments of the parasites to Australia. After he left India, many more batches of parasites were forwarded to him. The parasites, specially the chalcid *Syntomosphyrum indicum*, established itself and spread rapidly in Australia and have already been responsible to a very appreciable control of the serious fruit fly *Chætodacus tryoni*, that had threatened to become a great menace to the fruit industry in the Island.

* * *

"**Jutex**".—According to a recent *Bulletin* of the Indian Central Jute Committee, a new material, "Jutex", made from jute and artificial resin, is being manufactured by an Austrian firm. The material is light (sp. gr. 1·4), durable and firm, and finds a variety of uses in industries such as, manufacture of cog wheels, motor and motor car accessories, etc. It is described as a perfect substitute for metal and some Austrian factories are reported to have been using machine accessories made of this material.

* * *

The Seventh Annual Convention of the Sugar Technologists' Association of India was held at Cawnpore on 16th and 17th October 1938 under the chairmanship of Rao Saheb V. P. Iyer and was largely attended by members and visitors.

The President of the Association, Sirdar Kripal Singh Majithia, was unavoidably absent and his address was read by the Chairman. Among the important points dealt with in the address were the activities of the organisation—the Indian Sugar Syndicate, Ltd., the problems of the industry and suggestions for the formation of a Committee to introduce uniform methods of chemical control in factories.

While the number of papers presented at the Convention was less than the previous year, they were of a high technical standard and evidence a good deal of interesting and lively discussions.

A Business Meeting of the Association was held on 17th October when the Hon. Secretary, Mr. R. C. Srivastava, announced that 57 factories had joined the Association. He also said that the Association jointly with the Indian Sugar Mills Association, had approached the Government of India to invite the International Society of Sugarcane Technologists to hold their Seventh Session in India. Reviewing the position of sugar industry in India he pointed out that there was a decrease in production of sugar by 16·3 per cent. during the 1937–38 season due to less area under cane. A further shortage was expected in the coming season 1938–39.

* * *

The National Academy of Sciences, India.—At the meeting held on the 29th November, at the headquarters of the Academy, the Council decided to award the Education Minister's Gold Medal, to Prof. Birbal Sahni, SC.D., F.R.S., in consideration of his paper entitled "Materials for a Monograph of the Indian Petrified Palms", published in the *Proceedings* of the Academy. The Council elected Dr. Ram Behari, M.A., Ph.D., Reader in Mathematics, University of Delhi, and Mr. Saradindu Basu, M.Sc., Meteorologist, Upper Air Observatory, Agra, as Fellows of the Academy.

* * *

Indian Chemical Society.—At the ordinary meeting of the Society held on Friday, November 25, at the University College of Science, Calcutta, the following Office-bearers were elected by ballot, for the coming year.

President: Dr. H. K. Sen; *Vice-President*: Dr. P. Neogi; *Hon. Secretary* Dr. P. K. Bose; *Hon. Treasurer*: Dr. A. C. Sircar; *Hon. Editors*: Prof. P. C. Ray and Dr. J. N. Ray; *Hon. Auditors*: Dr. P. C. Nandi and Mr. T. K. Roychaudhury.

The following chemists were admitted as Fellows of the Society.—Mr. N. P. Datta, M.Sc. (*Calcutta*) and Mr. P. N. Bagchi, M.Sc. (*Calcutta*).

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Andhra University.—Mr. K. M. Pandalai, M.Sc., has been awarded the Ph.D. degree of the Andhra University in consideration of his thesis entitled "Biochemistry of Nitrification".

Mr. N. M. Philip has been awarded the degree of Master of Science (M.Sc. Hons.) in consideration of his thesis entitled "Compressibilities of Liquids in relation to Light Scattering and other Physical Properties."

Royal Institute of Science, Bombay.—(1) Prof. G. R. Paranjape has assumed charge as Principal of the Institute *vice* Dr. T. S. Wheeler on leave. (2) Dr. R. C. Shah has been appointed

to do duty as Professor of Organic Chemistry in place of Dr. T. S. Wheeler. (3) Dr. (Miss) Banoo Khanbatta has been appointed as an additional Assistant Lecturer in Chemistry. (4) Dr. Karandikar has taken the place of Mr. Bal (on leave in England) as Assistant Lecturer in the Zoology Department.

University of Calcutta.—The degree of Doctor of Sciences (D.Sc.) has been conferred on Mr. K. V. Giri, M.Sc., A.I.I.Sc., Nutrition Research Laboratory, Coonoor, in consideration of his thesis bearing annominats on enzymes.

University of Mysore.—*I. Examinations.*—The results of the L.M.P. Examinations held in October 1938 were published. They were as follows:—

		No. examined	No. passed
First L.M.P.	..	17	9
Second ,,	..	25	17
Third ,,	..	45	22
Final ,,	..	46	26

II. Extension Lectures.—The following lectures were delivered under the scheme of Extension Lectures during the month:—

(1) Dr. M. H. Krishna, M.A., D.Lit., Professor of History, Maharaja's College, Mysore, on "Archæology in Mysore", at Chikmagalur and Hassan; (2) Sriman Sangeetha Shastra Ratna Sangeetha Vidwan K. Vasudevacharya, Mysore, on "Music" at Mysore and Bangalore; (3) Dr. Gualtherus H. Mees, M.A. (Cantab.), LL.D. (Leyden), Fellow, Netherlands Sociological Society, "The Deeper Aspects of Education," at Mysore; "The Old Religions and the New Psychology," at Bangalore; (4) Mr. S. V. Viswanatha, M.A., L.T., retired Professor, Coimbatore, a course of three lectures: (i) "Pre-Historic Mysore," (ii) "Early Royal Dynasties," (iii) "Cultural Contribution of Early Mysore," at Mysore.

III. Meeting of the Senate.—The ordinary meeting of the Senate for the year was held on the 26th November 1938. Among the propositions that were passed, mention may be made of the following:—

(1) Institution of the following additional group of optional subjects in the Intermediate Science and the B.Sc. Pass degree course: Economics, Geology, Chemistry; (2) Reduction of the minimum for compartmental pass in the Intermediate examination from 45 to 40 per cent.; (3) Institution of the Honours course in Politics; (4) Revision of the Scheme in respect of the Second and the Final Examination for the M.B.B.S. degree; (5) Organization of a University Settlement; (6) Investigation of the question of abolishing the Medical School at Bangalore; (7) Making Physical Exercise compulsory in the University from the year 1939–40.

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Dr. J. S Patel, Oil Seed Specialist to the Government of Madras, has been appointed Jute Specialist under the Indian Central Jute Committee.

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Sir William Bragg has been elected President and **Prof. A. V. Hill** and **Prof. A. C. G. Egerton**, Secretaries of the Royal Society.

Announcements.

Lucknow University.—*Programme of Scienc Lectures for the Winter Session*, 1938–39.—

January 10, 11 and 12.—PROF. K. S. KRISHNA M.A., D.Sc.: "Magnetic Properties of Crystals. January 13, 14 and 15.—PROFESSOR W. BU RIDGE, D.M., M.A.: "Medical History, wit special reference to the Indigenous Systems India". January 16, 17 and 18.—PROF. N. SE GUPTA, M.A., PH.D., P.R.S.: "Heredity i Mental Traits". January 20, 21 and 22.—D A. N. SINGH, D.Sc.: "The Fundament Theorems of the Differential Calculus." Januar 28 and 29.—PROF. B. R. SETH, D.Sc.: "Tw Dimensional Potential Problems." Februar 11, 12 and 13.—DR. HANSRAJ GUPTA, M.A PH.D.: "The Theory of Integral Numbers" February 16, 17 and 18.—PROF. A. B. MISR "Reproduction in Indian Birds".

Indian Chemical Society.—The next Annu General Body Meeting of the Society will be hel at Lahore at 2-30 P.M., on 4th January 193 in the Chemistry Section meeting room of t Indian Science Congress.

The fourth Annual Meeting of the **Inte University Board** will be held in Bombay o 27–28 February, 1939.

National Institute of Sciences.—The Fourt Annual General Meeting of the Institute will b held on January 2, 1939, in the Hailey Hal Lahore.

Indian Statistical Conference.—The secon session of the Indian Statistical Conference wi be held in Lahore in the first week of Januar 1939. His Excellency the Governor of the Punja has kindly agreed to open the Conference o Thursday, the 5th January 1939. A Receptic Committee has been formed in Lahore with t Hon'ble Mr. Manohar Lal, Finance Minister the Punjab Government, as the Chairman.

The work of the Conference will be carried c in active co-operation with the Indian Scien Congress which will also meet in Lahore at t same time. A joint meeting will be held wi the Section of Mathematics and Physics of t Science Congress in which a special discussion wi be held on "the techinque of random samp surveys", and papers in theoretical statistics w be taken up for consideration. A joint discussi will be held in the Section of Anthropology "the application of statistical methods in anthr pometry"; and also a joint meeting with t Section of Agriculture. Attempts are being ma to arrange a joint discussion with the Section Medicine and Public Health. There will be special section of the Conference devoted *Economic and Business Statistics.*

The first **All-India Conference of Ment Specialists** will be held in Lahore on 23- January, 1939. The Conference has been orga ised by the newly formed Indian Division the Royal Medico-Psychological Association.

Our attention has been drawn by Mess Thomas Murby and Co., London, to an err review notice on *Agricultural Analysis* C. H. Wright, appearing in this Journ

(October. 1938, p. 190). It is mentioned that the author has omitted to refer to the polariscopic method for the estimation of sugar. We have now been informed that this is not correct. The method for determining lactose in milk (p. 235 of the book) and sucrose in sweetened condensed milk (p. 261) are both polariscopic methods. We regret the error.

We acknowledge with thanks receipt of the following :—

"Nagpur Agricultural College Magazine," Vol. 13, No. 2.

"Agricultural Gazette of New South Wales," Vol. 49, No. 11.

"Journal of Agricultural Research," Vol. 57, No. 7.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 29, No. 10.

"The Philippine Agriculturist," Vol. 27, No. 6.

"Journal of the Royal Society of Arts," Vol. 86, Nos. 4484–87.

"Biochemical Journal," Vol. 32, No. 10.

"Biological Abstracts," Vol. 12, No. 7.

"Journal of the Institute of Brewing," Vol. 44, No. 11.

"Chemical Age," Vol. 39, Nos. 1009–12.

"Journal of Chemical Physics," Vol. 6, No. 11.

"Journal of the Indian Chemical Society," Vol. 15, No. 9.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 71, Nos. 11 and 12.

"Experiment Station Record," Vol. 79, No. 5.

"Transactions of the Faraday Society," Vol. 34, No. 211.

"Forschungen und Fortschritte," Vol. 14, Nos. 31–33.

"Genetics," Vol. 23, No. 6.

"Journal of the Geological, Mining and Metallurgical Society of India," Vol. 9, Nos. 1–2.

"Review of Applied Mycology," Vol. 17, No. 11.

"American Museum of Natural History," Vol. 42, No. 4.

"Nature," Vol. 142, Nos. 3600–03.

"Journal of Nutrition," Vol. 16, No. 5.

"Canadian Journal of Research," Vol. 16, No. 10.

"Journal of Research" (National Bureau of Standards), Vol. 20, No. 6.

"Sky," Vol. 3, No. 1.

"Indian Trade Journal," Vol. 131, Nos. 1690–92.

"Arkiv *fur* Zoologie," Vol. 30, Nos. 1–2.

Catalogues.

"Books for Students of Medical and Allied Sciences," Macmillan & Co., Ltd., London.

"Monthly List of Books on Natural History and Science,"—November 1938. Wheldon & Wesley Ltd., London.

ACADEMIES AND SOCIETIES.

Indian Academy of Sciences:

November 1938. SECTION B.—RAMA NAGINA SINGH : *The Oedogoniales of the United Provinces, India—I.* G. N. RANGASWAMI AYYANGAR, V. PANDURANGA RAO AND B. W. X. PONNAIYA : *The Occurrence and Inheritance of Purple-tipped Grains in Sorghum.* C. V. GANAPATHY AND B. N. SASTRI : *The Natural Activators of Papain.*

National Academy of Sciences, India:

November 29, 1938.—RAM BEHARI : *Osculating Quadrics of a Ruled Surface.*

Indian Chemical Society:

September 1938.—DINES CHANDRA SEN : *A Method for the Estimation of Cobalt in Presence of Nickel.* PARES CHANDRA BANERJEE : *Use of Vanadous Sulphate as a Reducing Agent, Part III.—Estimation of Cerium.* AMRITANSU SEKHAR CHAKRAVARTI AND BALABHADRA PRASAD: *Viscosity and Density of Cadmium Chloride Solutions at 35°.* N. C. SEN GUPTA : *On the Moving Boundary Method for the Determination of Cataphoresis of Colloids.* MUHAMMAD QUDRAT-I-KHUDA, AKBAR ALI MALLICK (in part) AND ASHUTOSH MUKHERJI : *Strainless Monocyclic Rings, Part III.—Synthesis of 2-Methyl-*cyclo*hexane-Succinic Acid and the Separation of its Isomers.* HIRENDRA NATH DAS-GUPTA : *Studies in Organo-arsenic Compounds. Part VIII.—Synthesis of Arsindole Derivatives from Phenylacetylene.* HIRENDRA NATH DAS-GUPTA : *Studies in Organo-arsenic Compounds, Part IX.—Synthesis of Arsenic Analogue of Succinimide.* SISIR KUMAR GUHA : *Indigoid Vat Dyes of the Isatin Series, Part III.—3-Indole-2′-(4′-methyl) Thionaphtheneindigos.* S. S. DESHAPANDE : *Essential Oil from Flower Kewda* (Pandanus Odoratissimus). U. P. BASU : *On Certain Salts of Alkaloids.* P. K. BOSE AND H. H. FINLAYSON *Occurrence of Psoralen in* Phebalium Argentum Smith.

* * *

South Indian Science Association, Bangalore:

November 28, 1938.—DR. M. V. GOVINDASWAMY : *Criminal Children and their Institutional Treatment.*

December 7, 1938.—DR. S. RAJU IYENGAR : *The Health of the School Children.*

December 16, 1938.—MR. C. J. H. PENNING : *Some Aspects of the Indian Sugar Industry.*

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